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Yamada et al.

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(54) **FUEL SUPPLY DEVICE**

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(73) Assignee: **Denso Corporation**, Kariya (JP)

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Apr. 23, 2008 (JP) 2008-112992

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F02M 37/00 (2006.01)
F02M 37/04 (2006.01)

(52) **U.S. Cl.** **123/509**; 123/510

(58) **Field of Classification Search** 123/509, 123/510

See application file for complete search history.

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Primary Examiner—Thomas N Moulis
(74) *Attorney, Agent, or Firm*—Nixon & Vanderhye, PC

(57) **ABSTRACT**

A fuel supply device includes a subtank in a fuel tank, a fuel pump in the subtank having a first pump unit suctioning fuel in the subtank to supply fuel to an external equipment and a second pump unit suctioning fuel outside the subtank to pump fuel into the subtank, and a filter connected to a first suction port of the first unit and a second suction port of the second unit and filtering supply fuel supplied to the equipment and pump fuel pumped into the subtank. The filter includes a case, a first filter, and a second filter. The first filter in a first passage of the case directing fuel in the subtank into the first port filters the supply fuel. The second filter in a second passage of the case directing fuel outside the subtank into the second port filters the pump fuel.

39 Claims, 13 Drawing Sheets

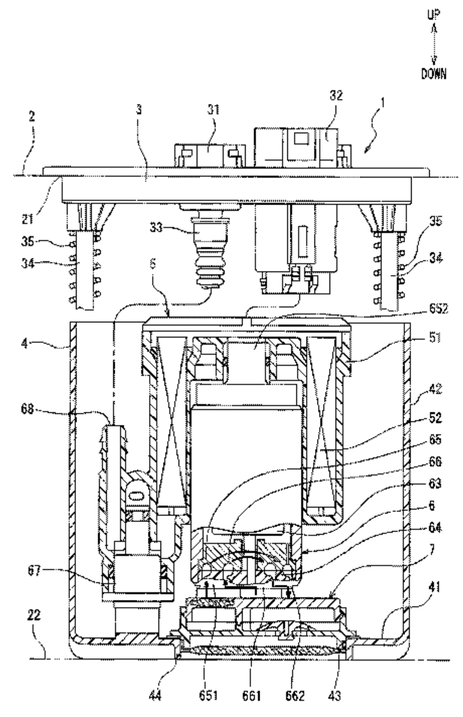
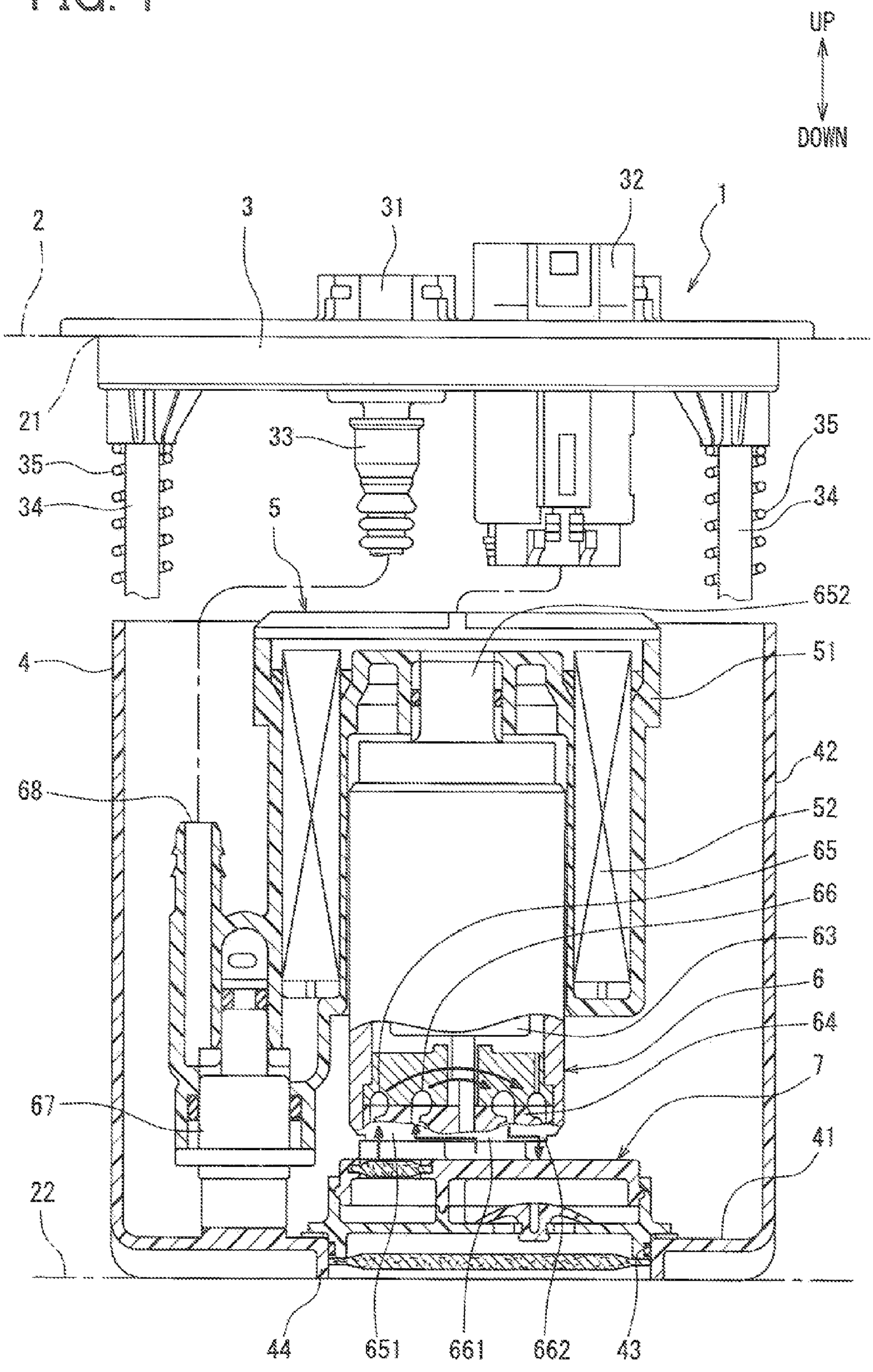


FIG. 1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6
64
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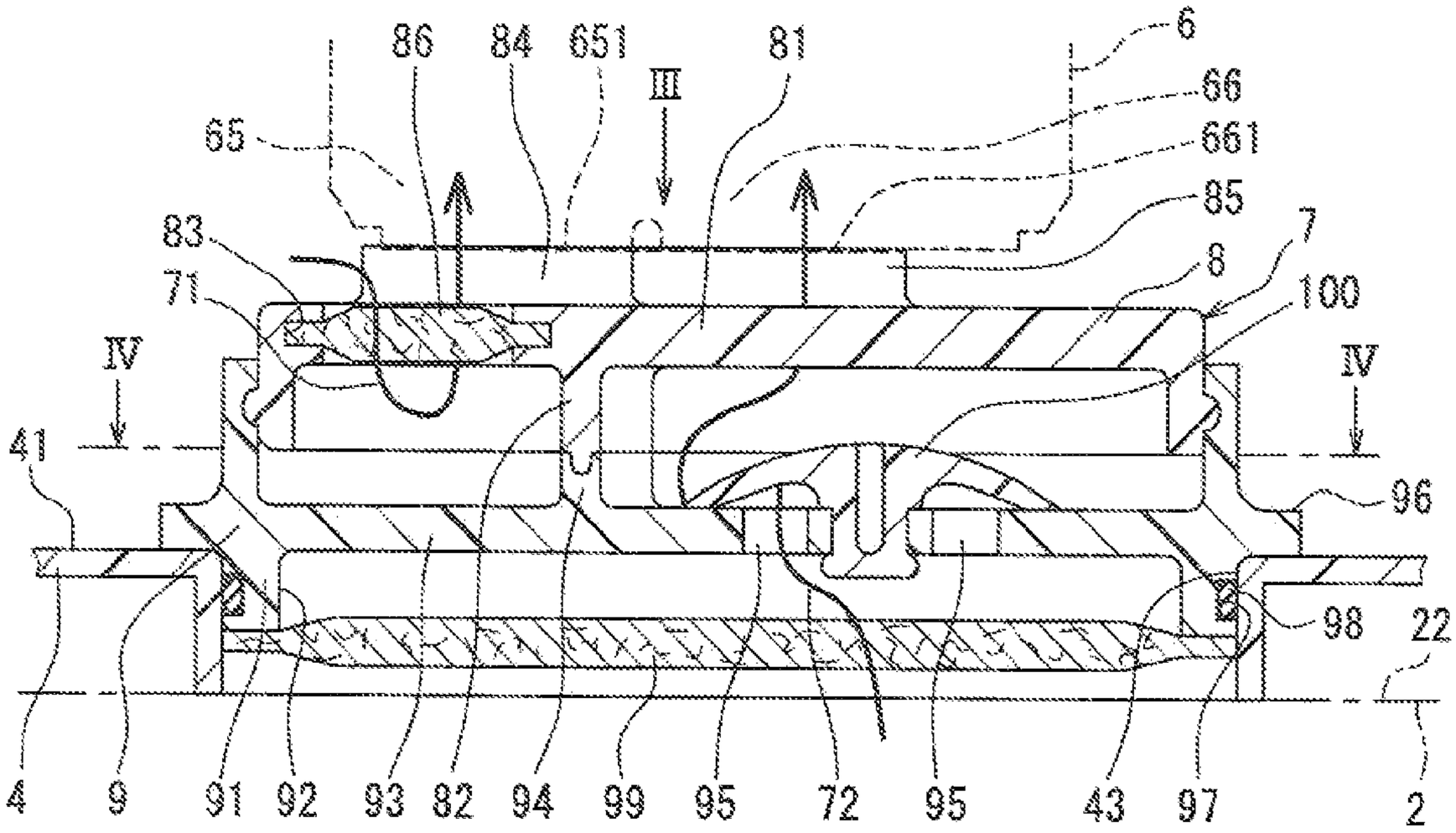
22
44
651
661
662
43

FIG. 2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66
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65
85
83
7
8
71
100
IV
IV
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96
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9
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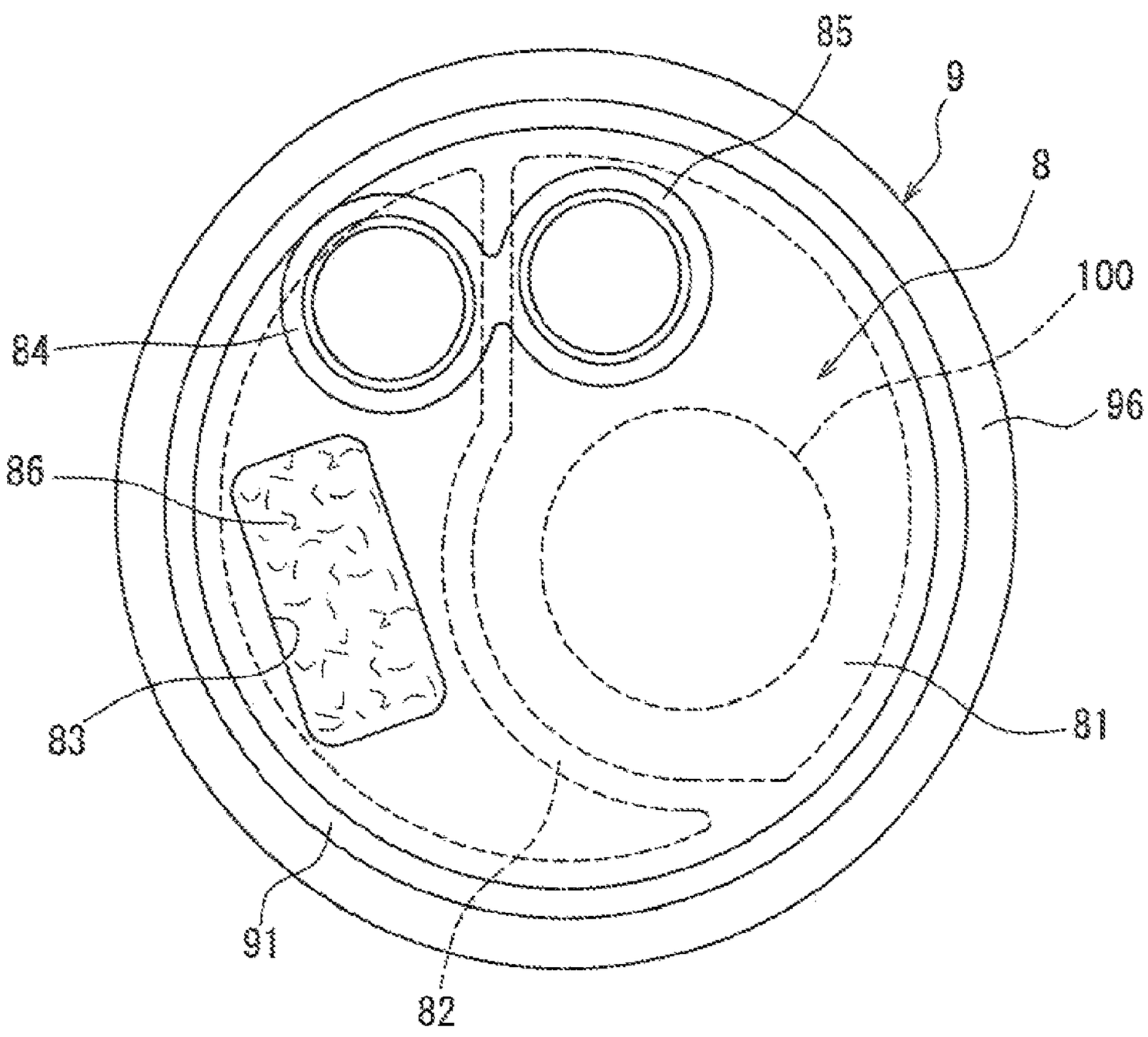
92
93
82
94
99
95
72
95
43
97
2

FIG. 3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84
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86
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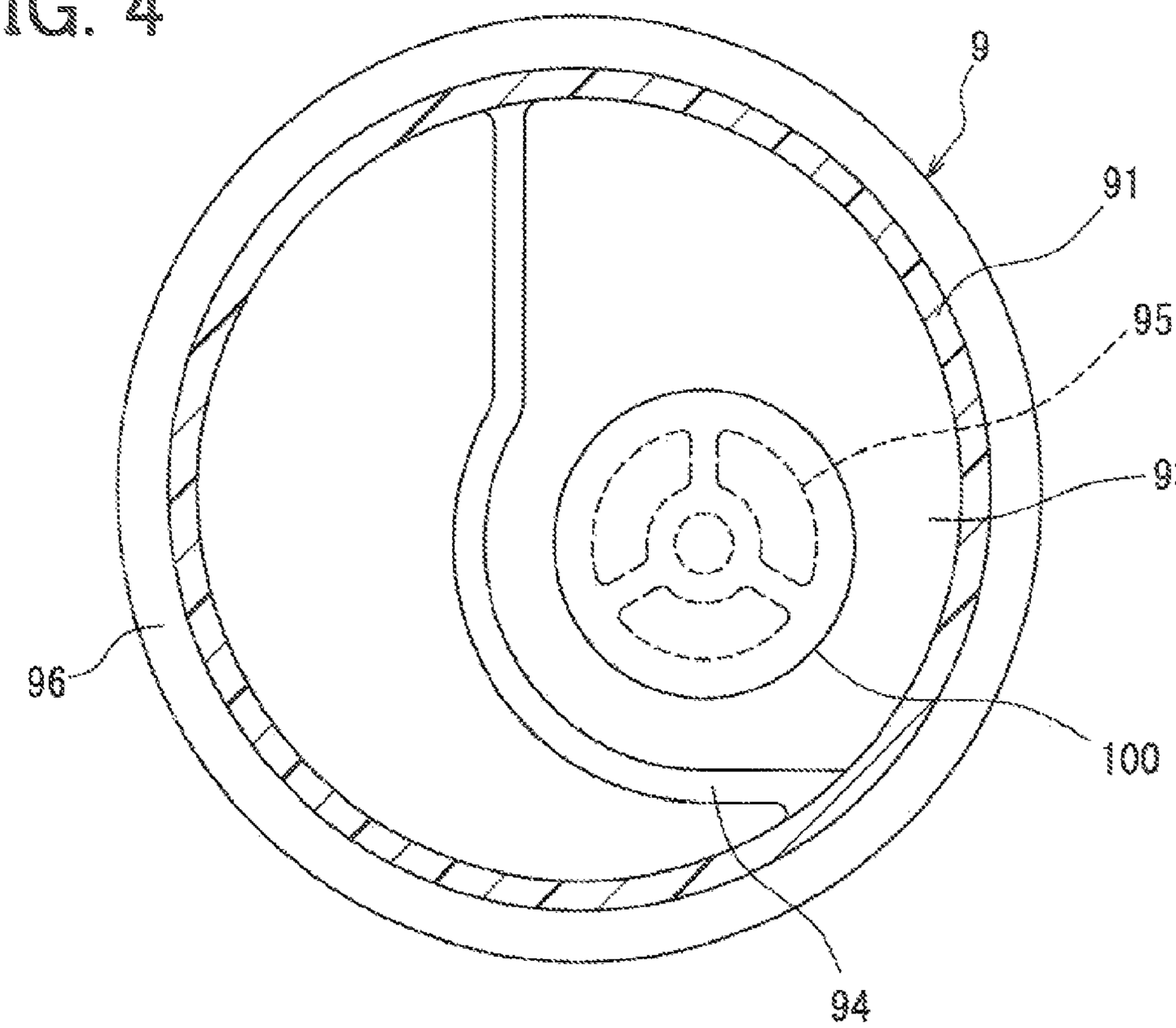
82

FIG. 4



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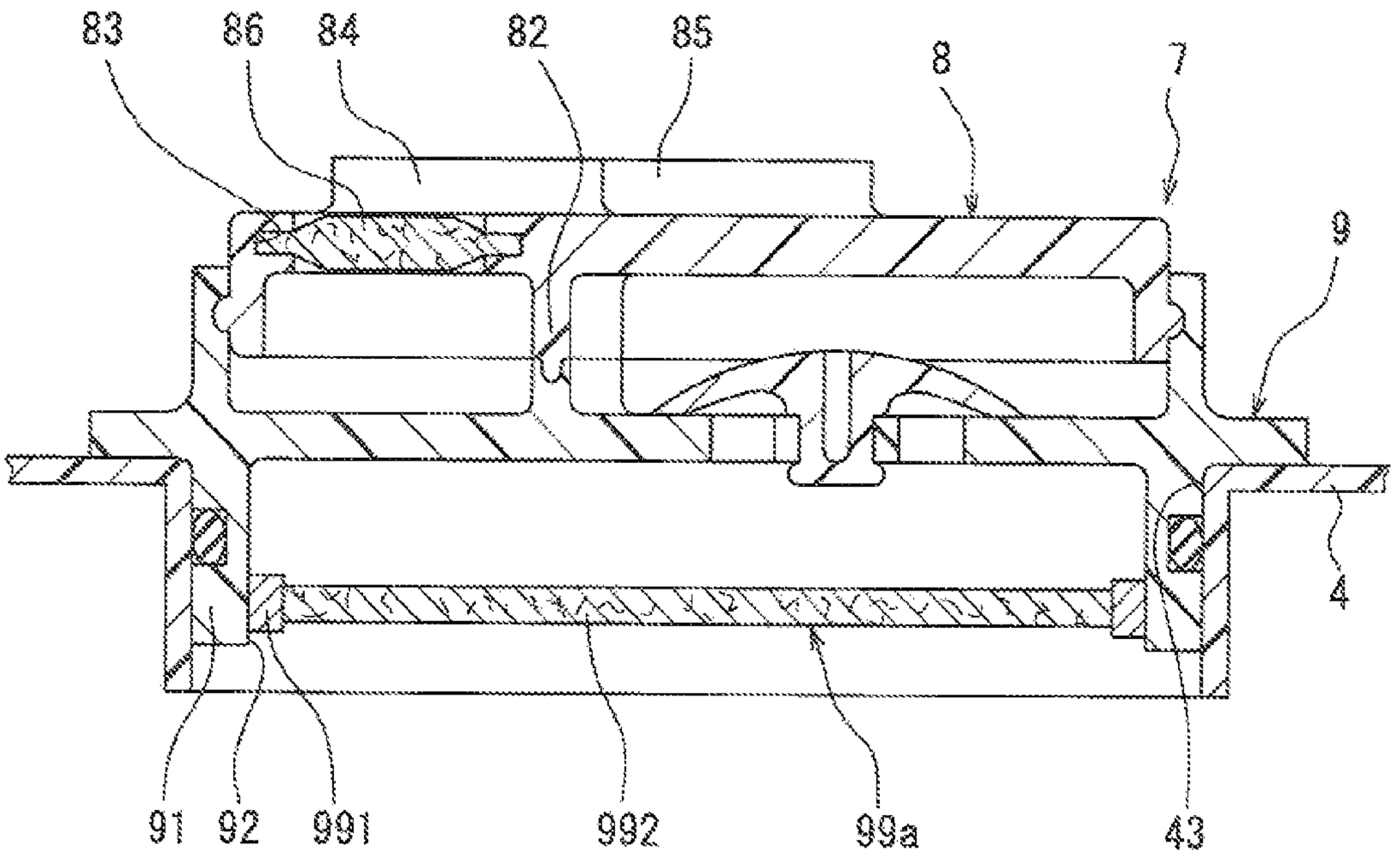
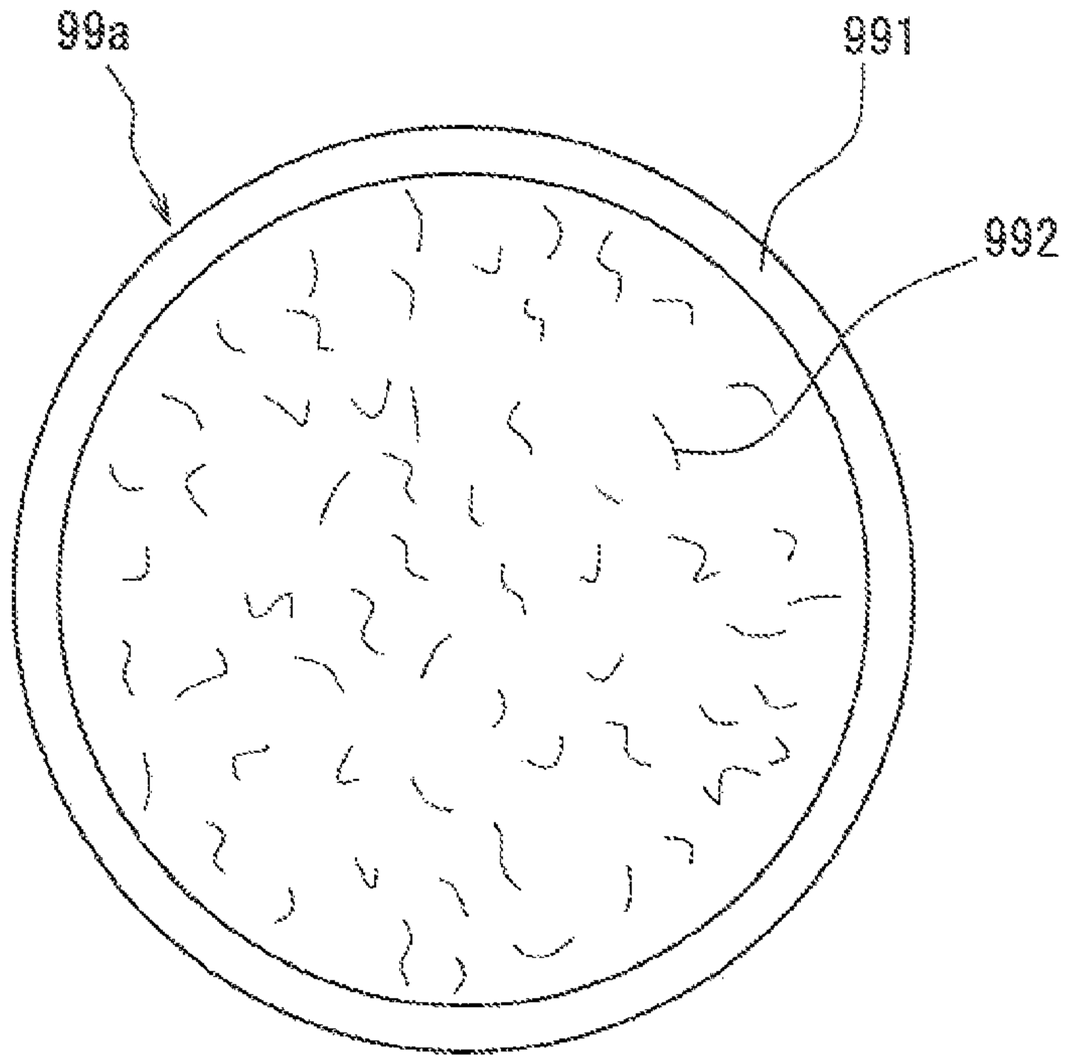


FIG. 6



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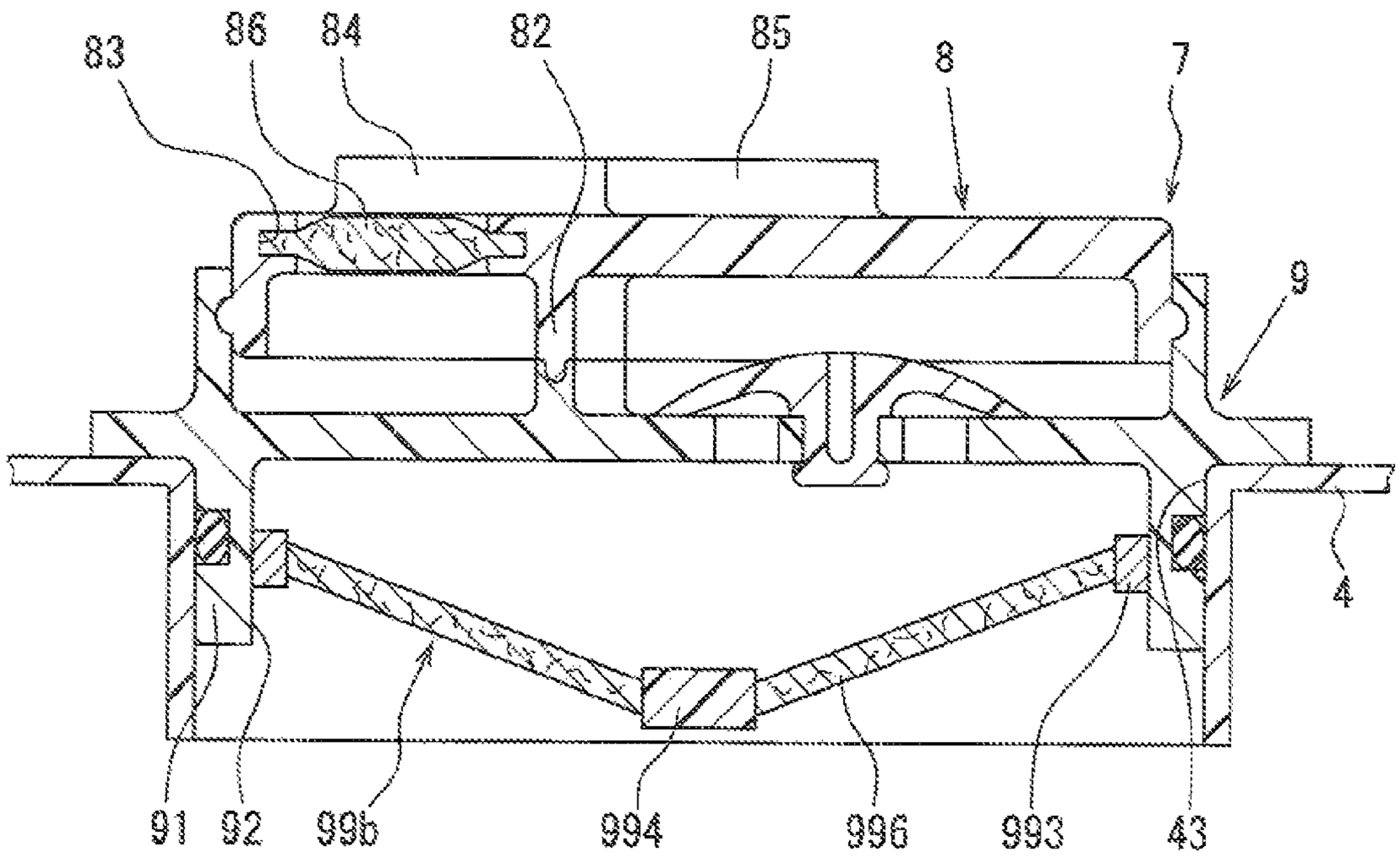
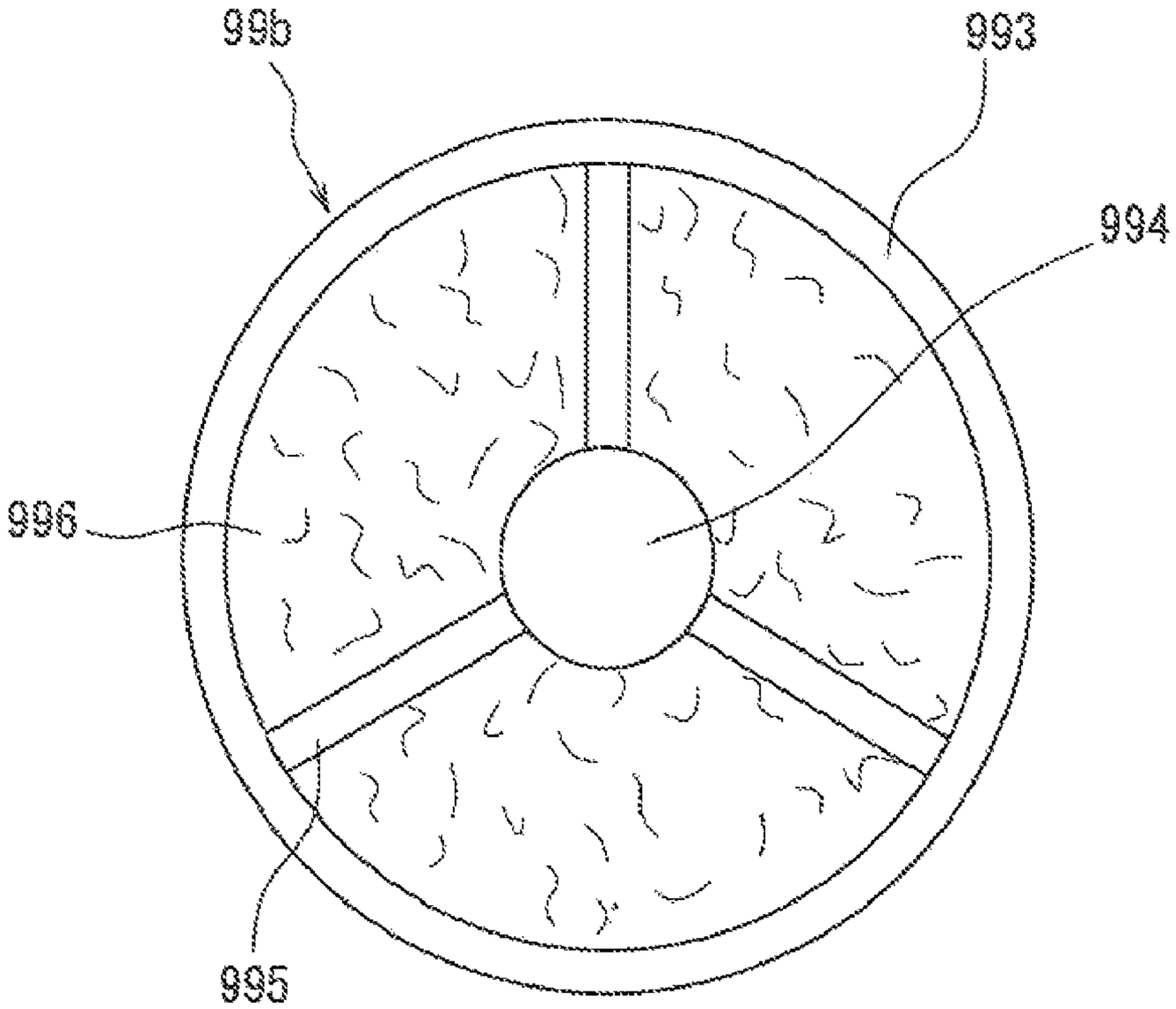


FIG. 8



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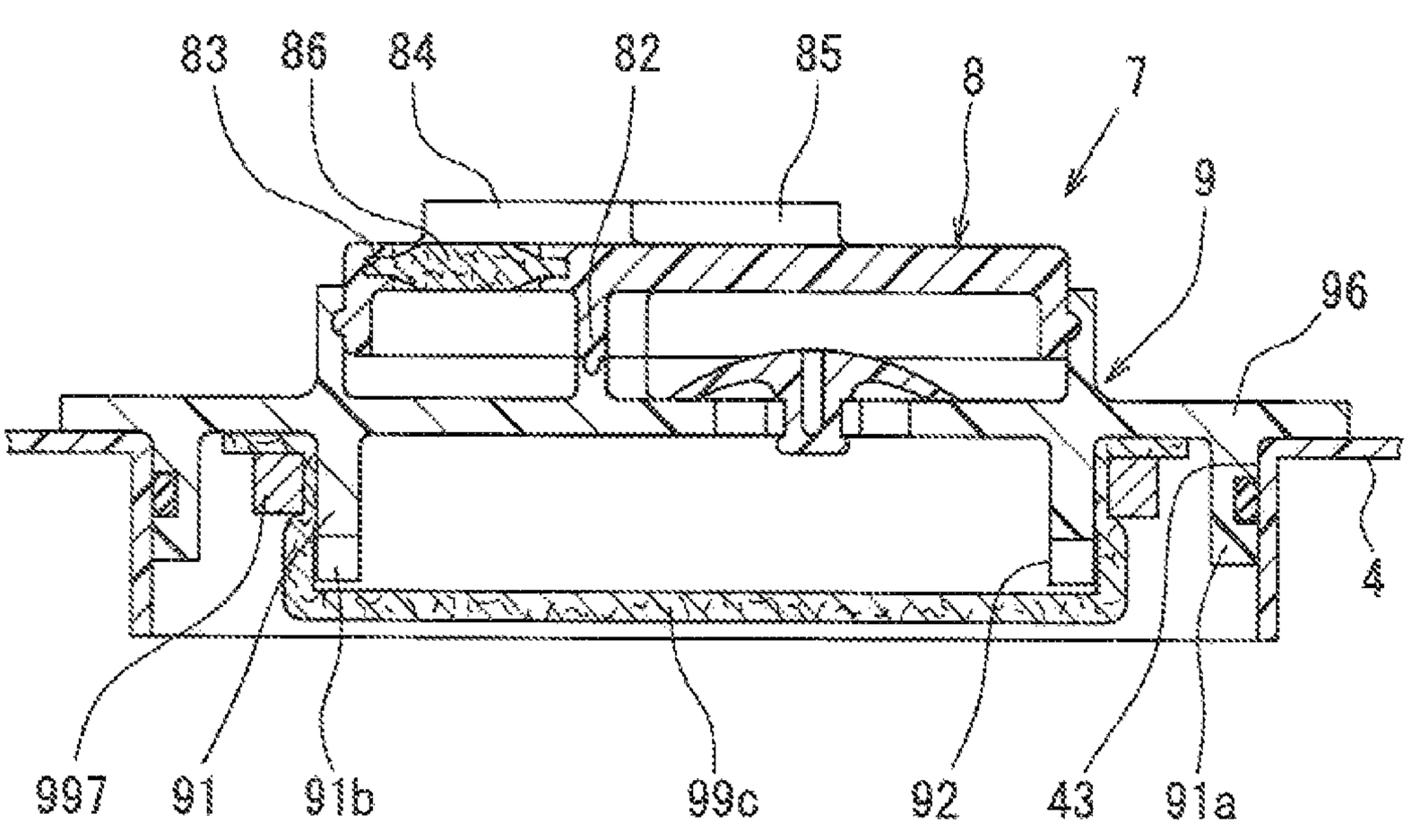

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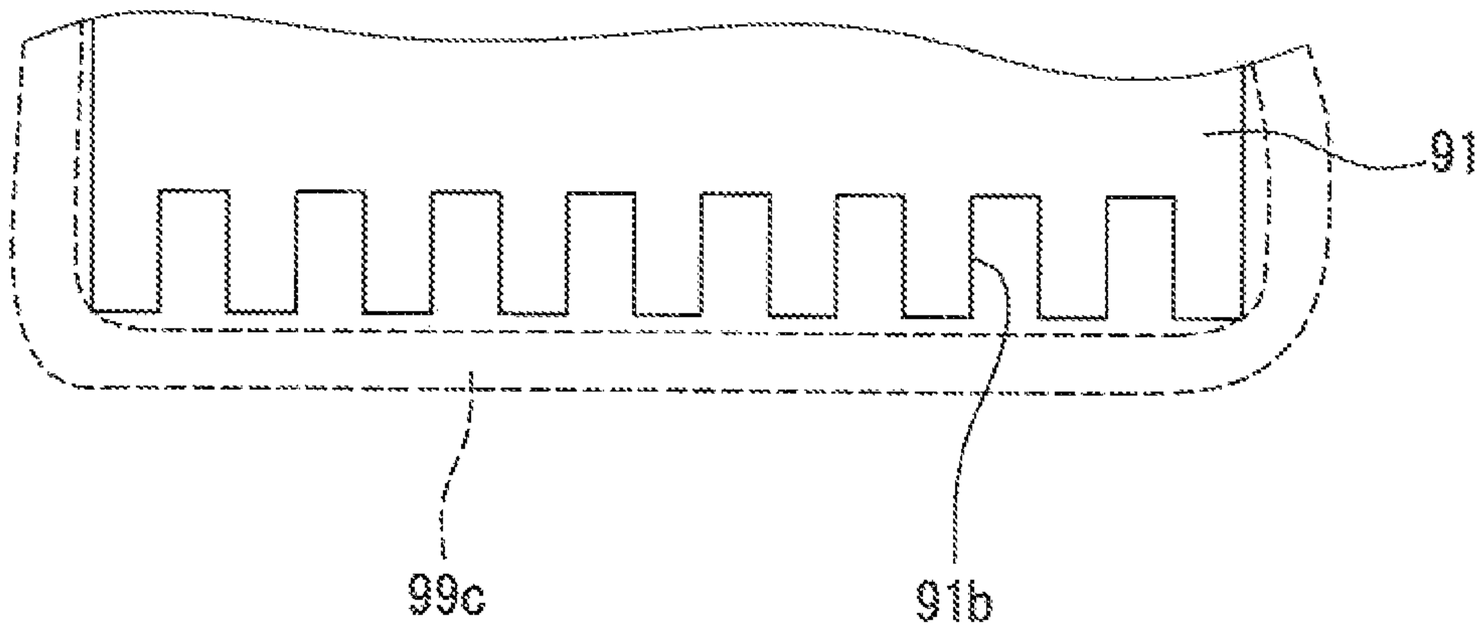

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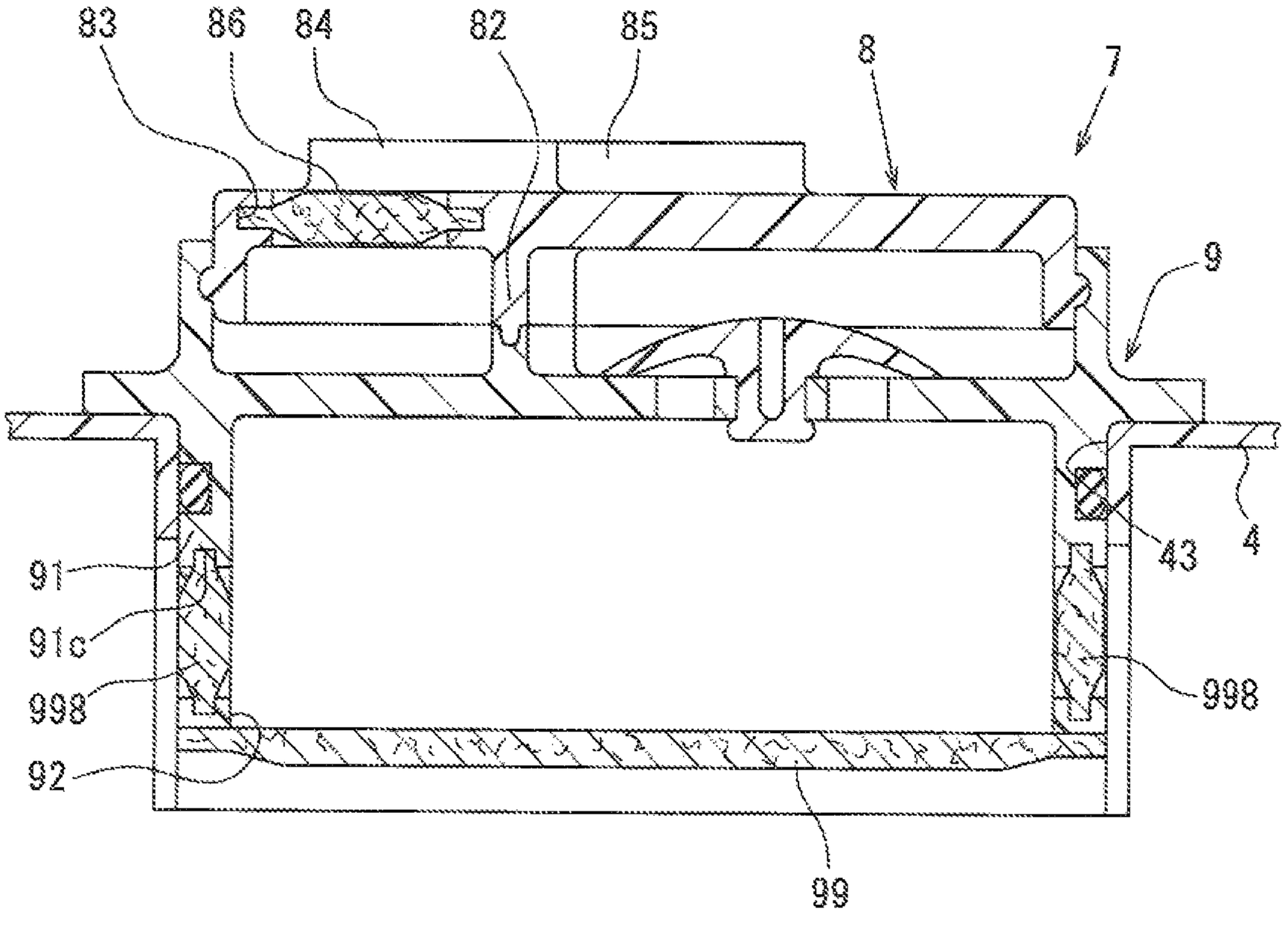

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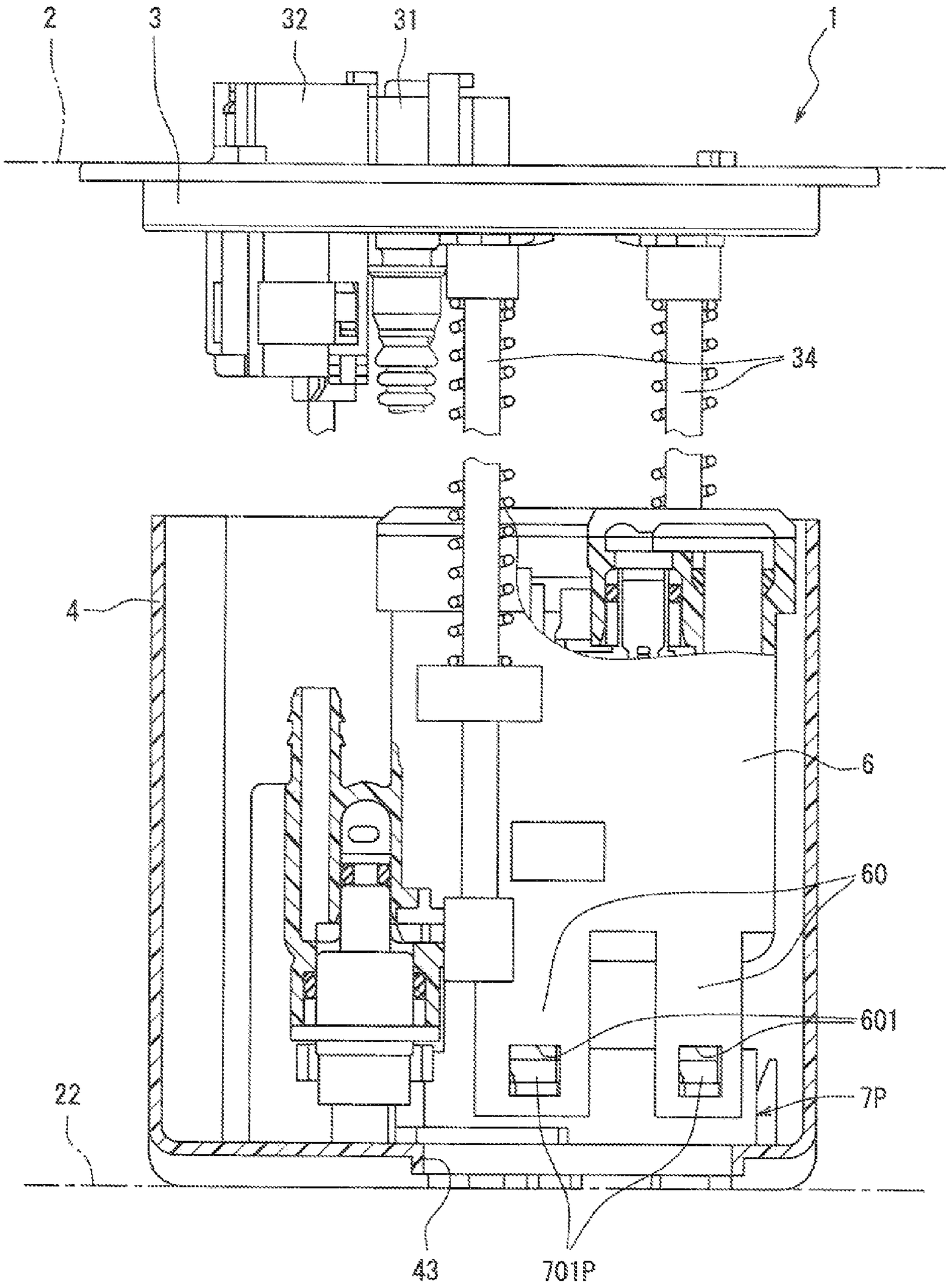

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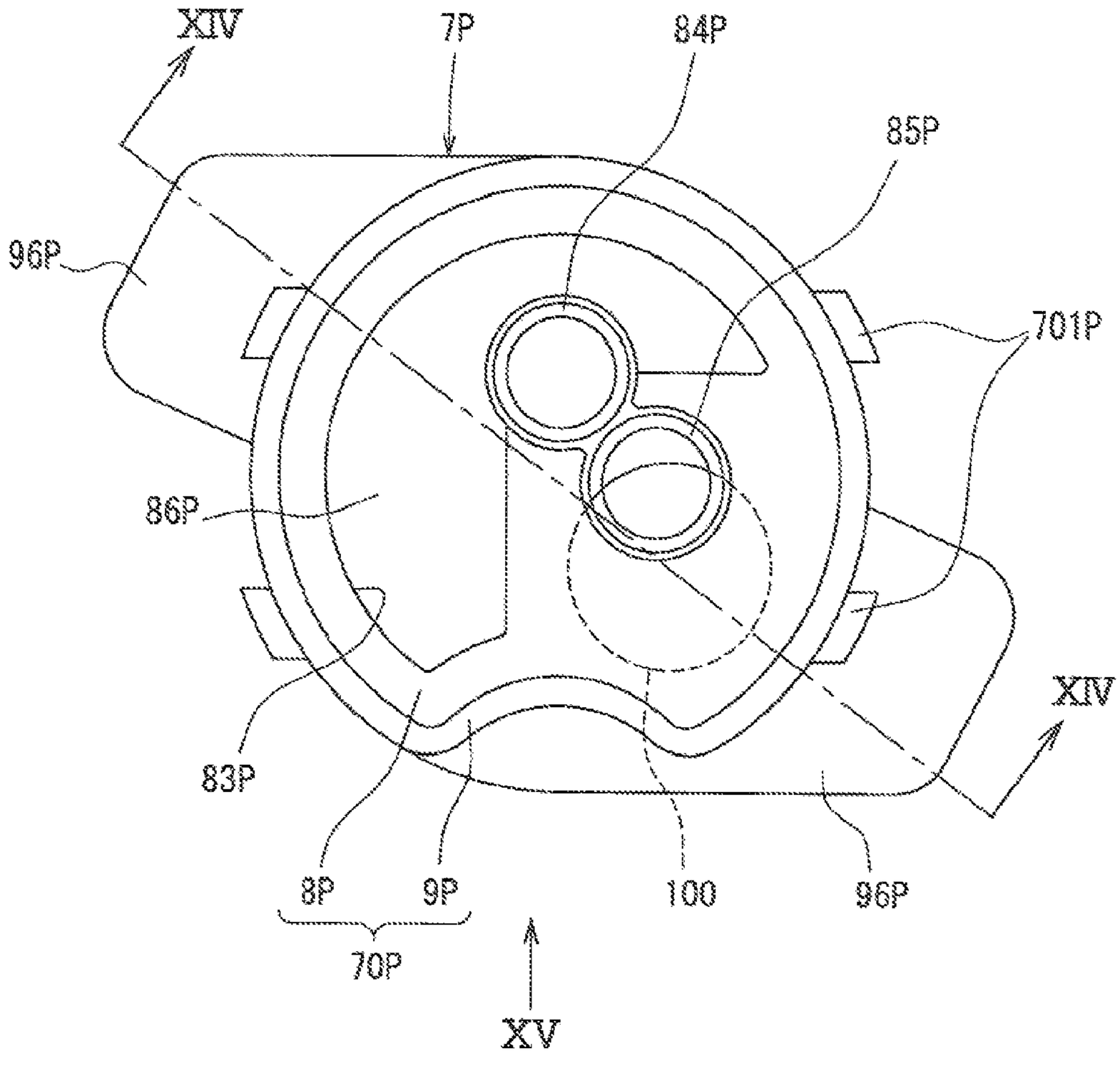
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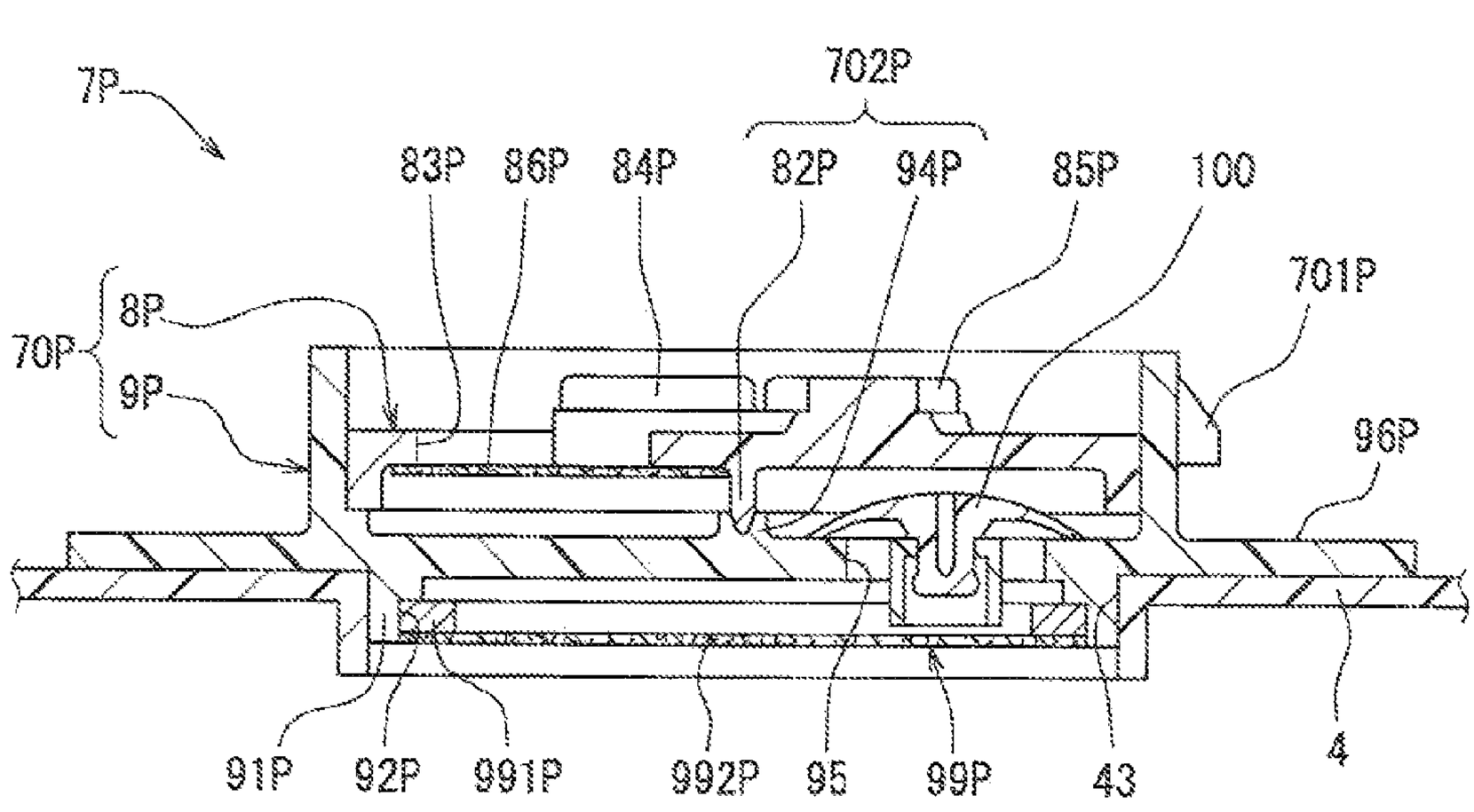
96P
701P
86P
XIV
83P
8P
9P
100
96P
70P
XV

FIG. 14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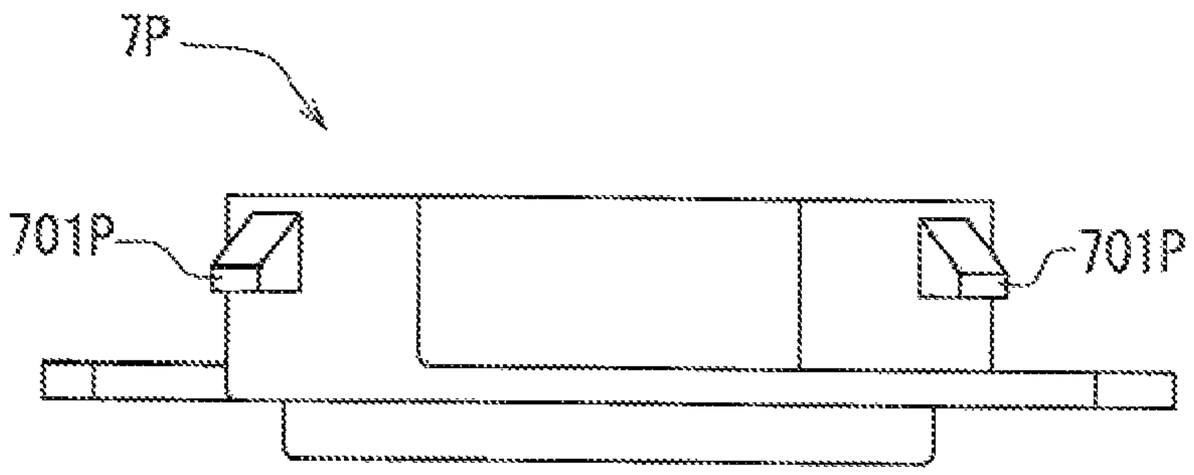
96P
91P
92P
991P
992P
95
99P
43
4

FIG. 15



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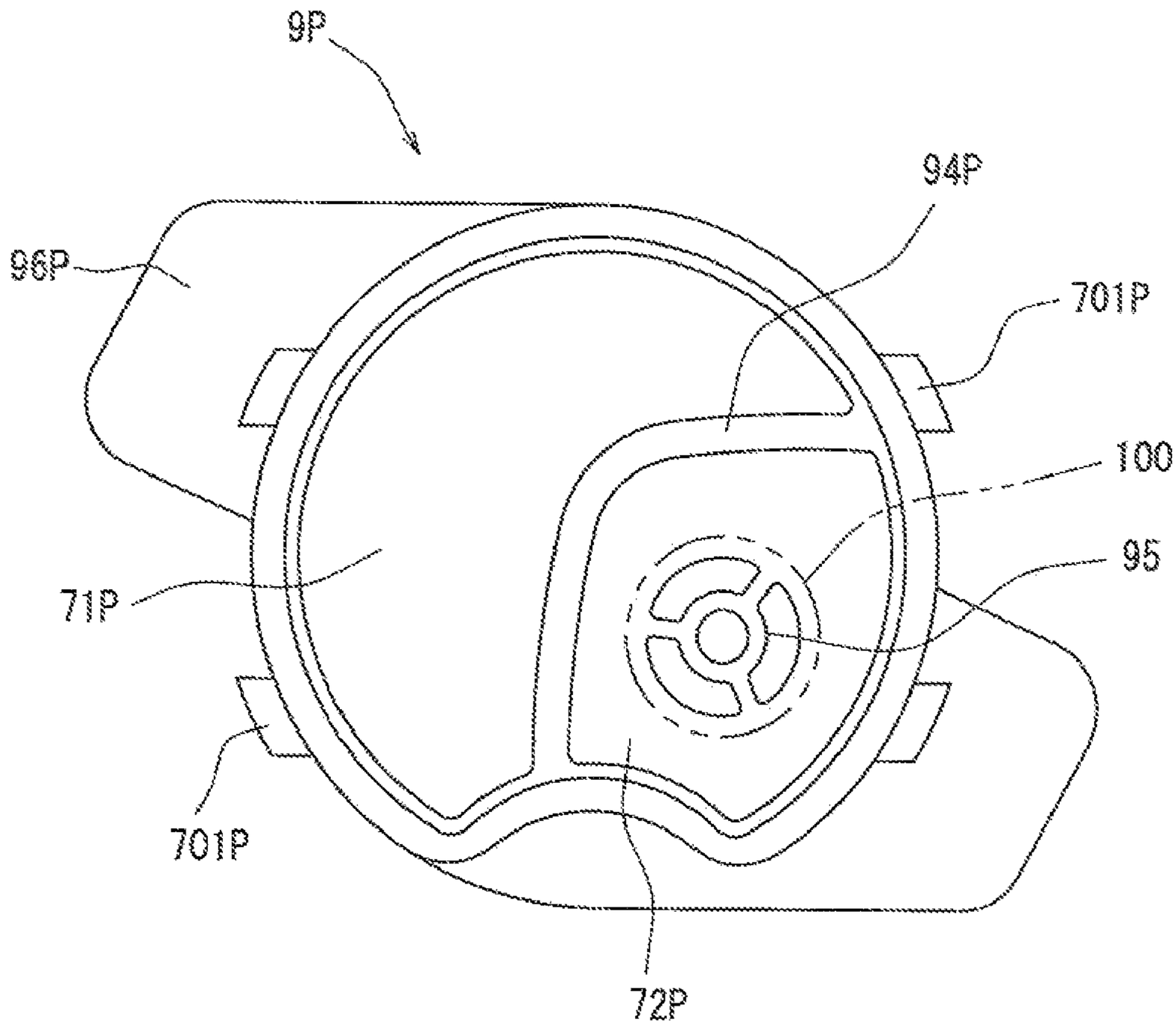

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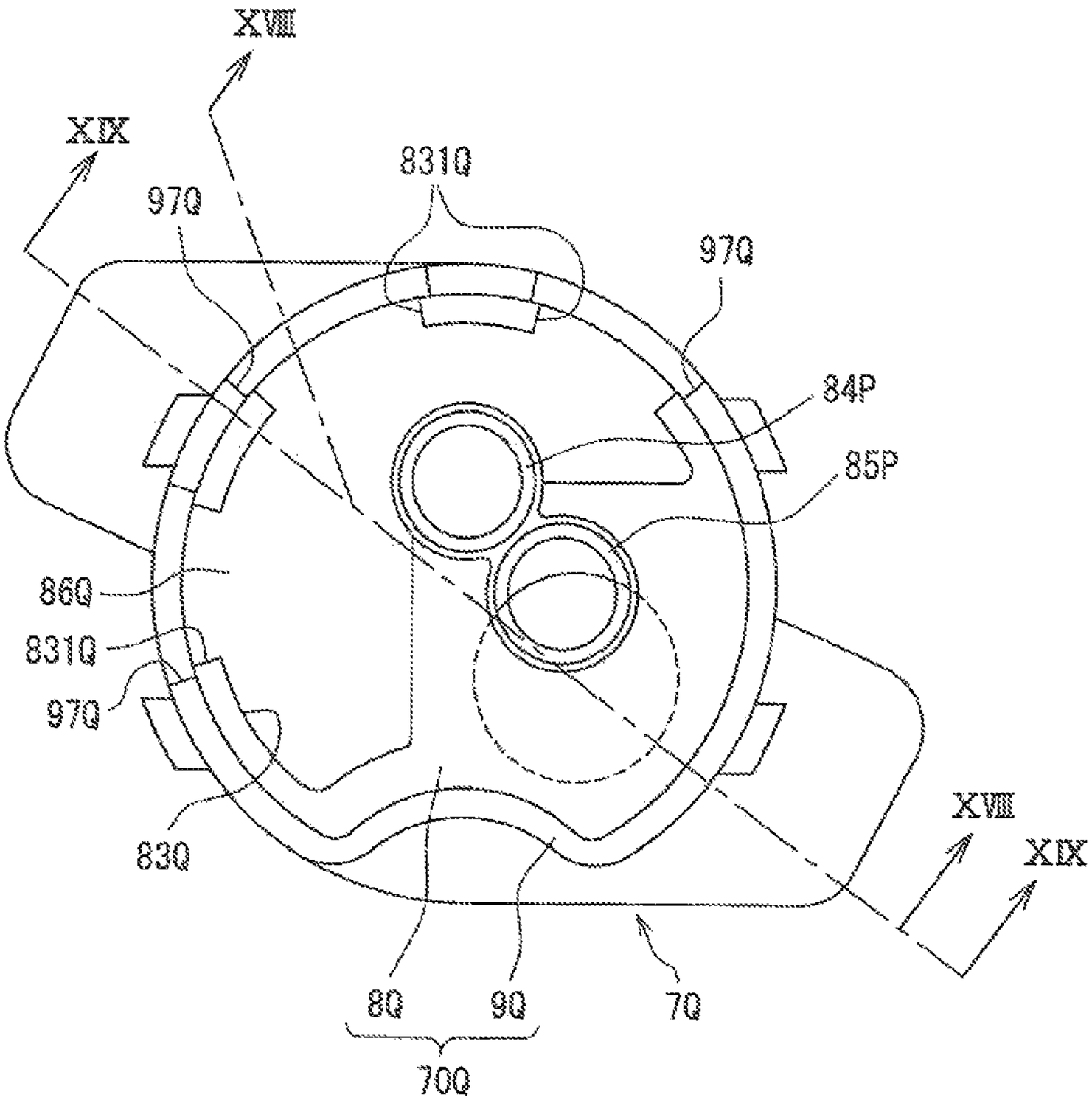
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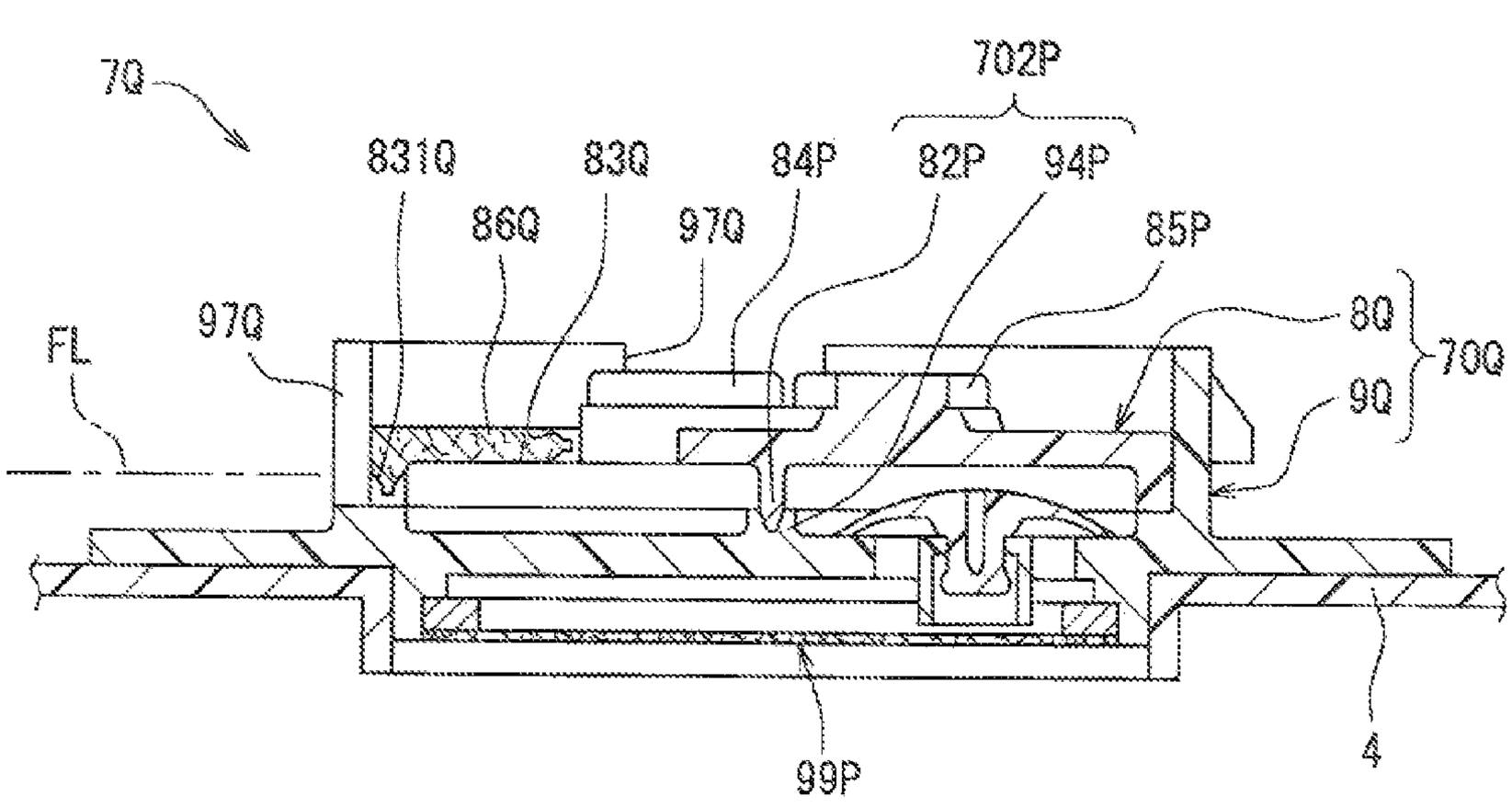
8Q
9Q
7Q
700

FIG. 18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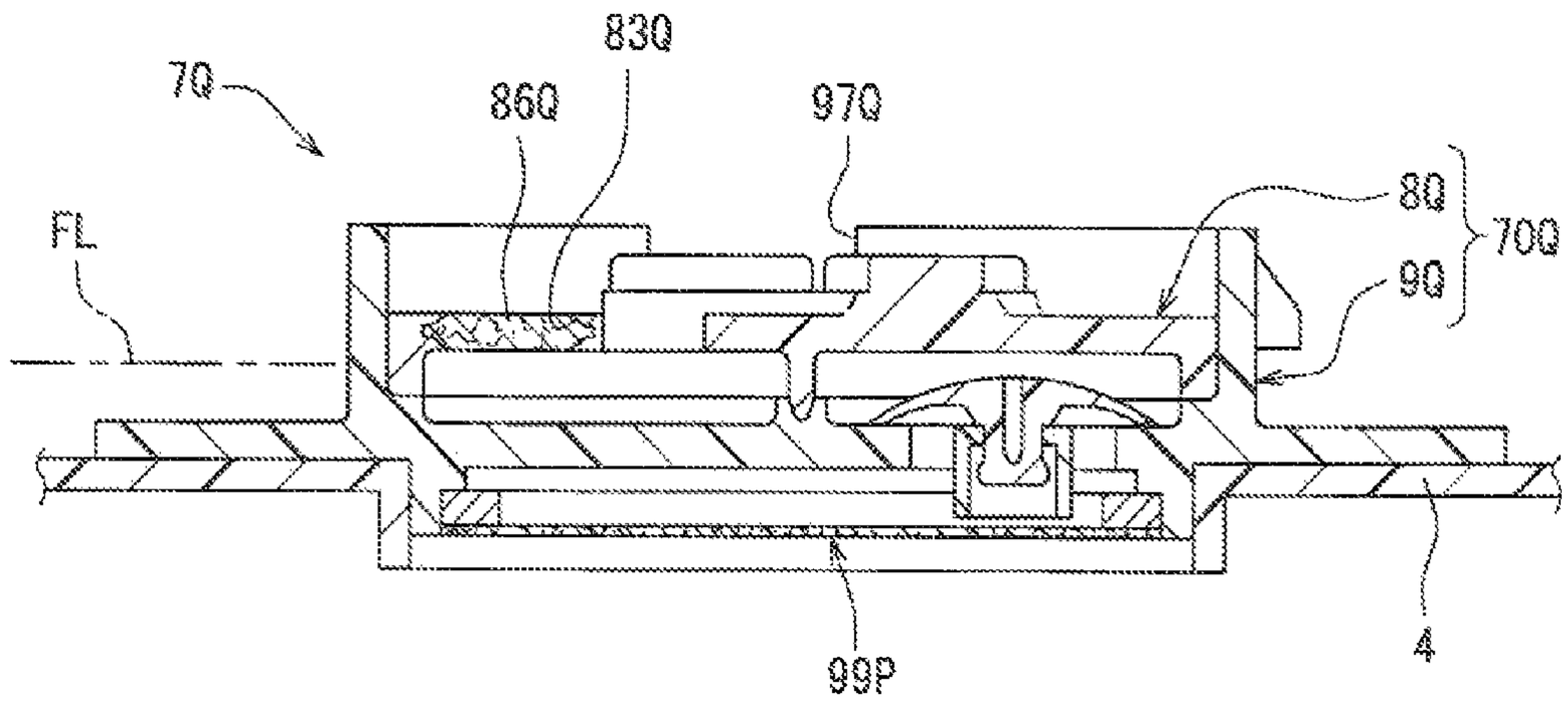
4

FIG. 19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9Q
FL
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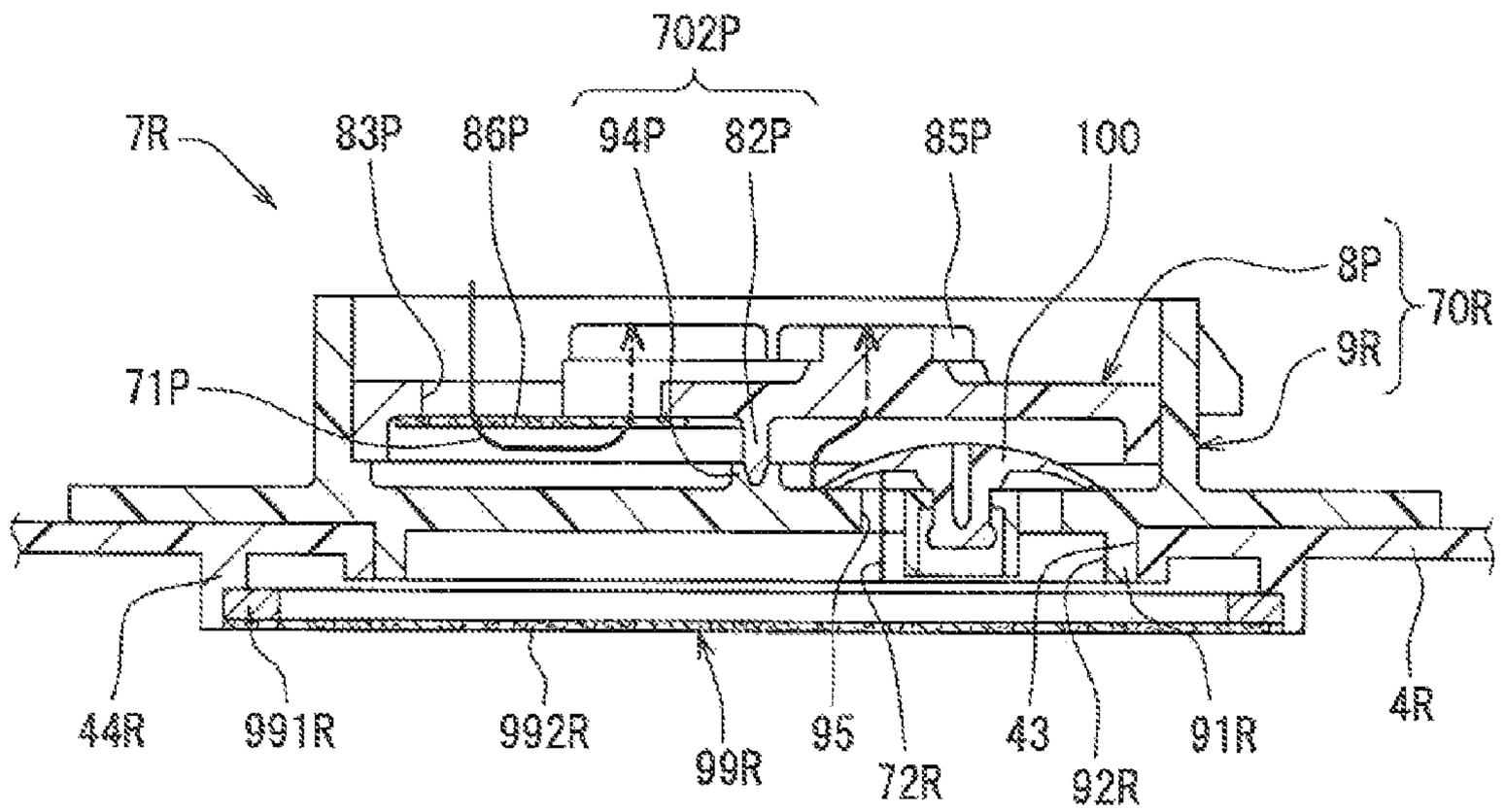
FIG. 20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86P
94P
82P
85P
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8P
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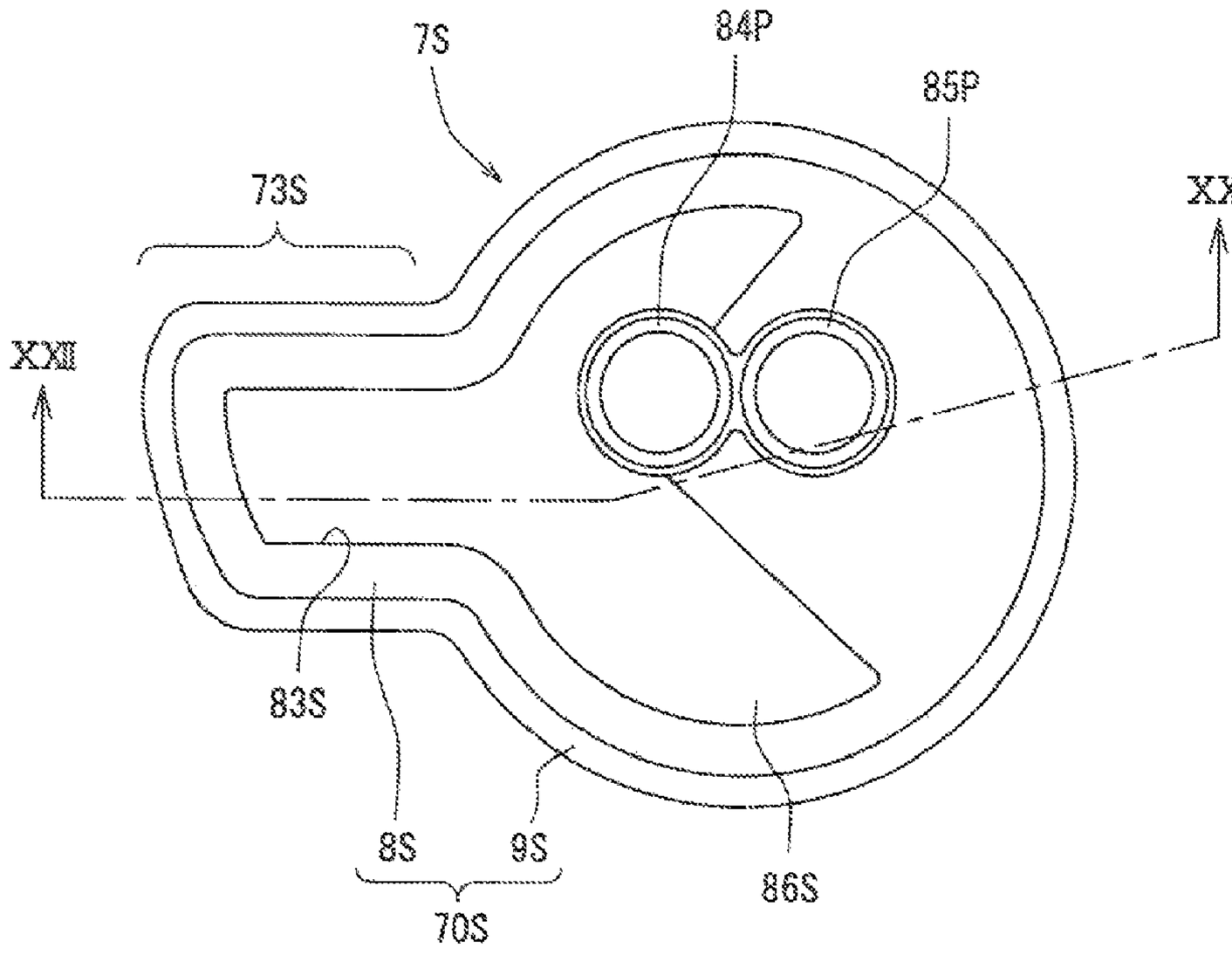
9R
71P
44R
991R
992R
99R
95
72R
43
92R
91R
4R

FIG. 21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70S
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FIG. 22

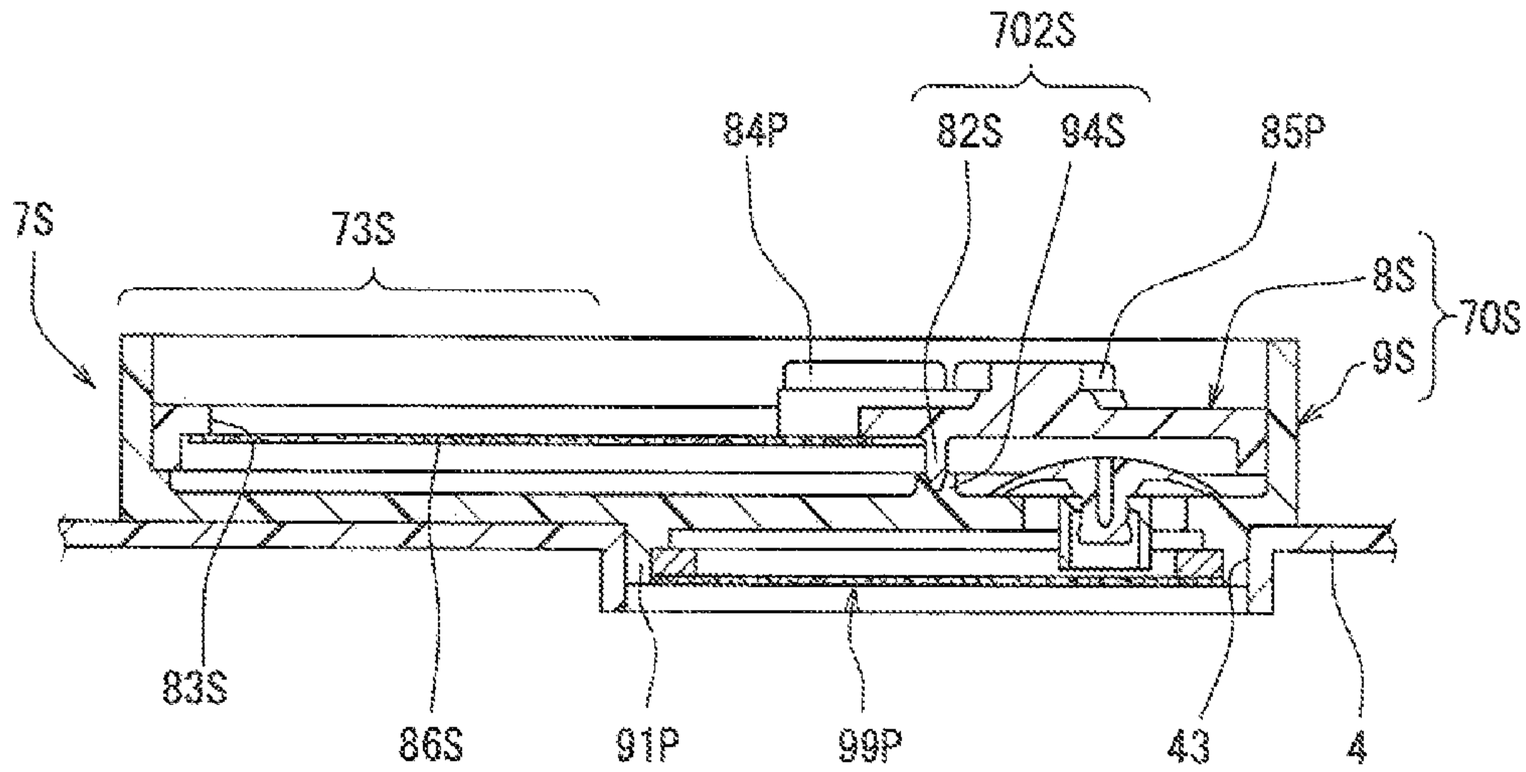
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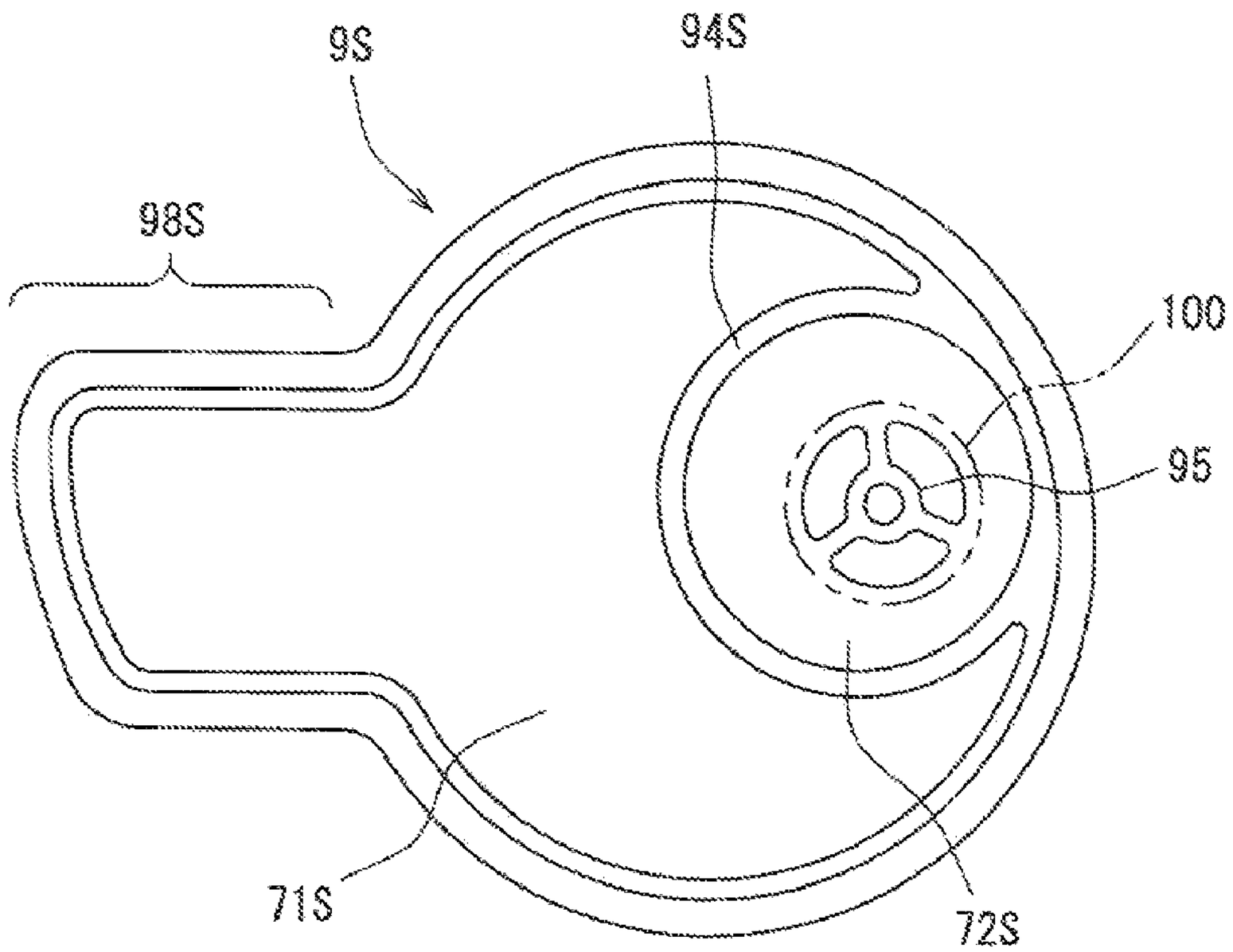
FIG. 23



FUEL SUPPLY DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This application is based on and incorporates herein by reference Japanese Patent Application No. 2007-191141 filed on Jul. 23, 2007 and Japanese Patent Application No. 2008-112992 filed on Apr. 23, 2008.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a fuel supply device.

2. Description of Related Art

There is known a fuel supply device for stably supplying fuel even if a remaining amount of the fuel in a fuel tank decreases (for example, refer to U.S. Pat. No. 5,596,970). The fuel supply device in U.S. Pat. No. 5,596,970 is accommodated in the fuel tank. The fuel supply device is provided with a sub tank for accumulating a part of the fuel in the fuel tank, and a fuel pump accommodated in the sub tank. The fuel pump includes a first pump unit for suctioning the fuel in the sub tank to supply the suctioned fuel to a fuel consumption device, and a second pump unit for suctioning fuel outside of the sub tank to pump up the suctioned fuel into the sub tank. Each suction port of the first and second pump units is provided with a filter member equipped with a bag-shaped filter element for trapping foreign matter in the fuel to be suctioned therein.

A tube for pumping-up fuel extends from the suction port of the second pump unit through an opening formed in the sub tank to an outside of the sub tank and the bag-shaped filter element is fixed to an inlet of the pumping-up tube. Therefore, the second pump unit suctions the fuel outside of the sub tank through the bag-shaped filter element and suctions the fuel into the suction port of the second pump unit through the pumping-up tube.

However, the filter member in the conventional fuel supply device has two filter members including a first filter member connected to the suction port of the first pump unit and a second filter member connected to the suction port of the second pump unit.

In this construction, the two filter members are required for manufacturing a single fuel supply device, and use of the two filter members increases the man hour for assembling the fuel supply device, leading to an increase of costs of the fuel supply device.

Further, since the two filter members are respectively provided with the bag-shaped filter elements, a distance between the suction port of the second pump unit and the inlet of the pumping-up tube, that is, a length of a flow passage for pumping-up fuel from the second pump unit is made longer. Therefore, the high suction force is required of the second pump unit.

SUMMARY OF THE INVENTION

The present invention addresses the above disadvantages. Thus, it is a first objective of the present invention to reduce manufacturing costs of a fuel supply device, which includes a fuel pump having a first pump unit for supplying fuel in a sub tank to a fuel consumption device and a second pump unit for pumping up fuel outside the sub tank into the sub tank. In addition, it is a second objective of the present invention to shorten a length of a flow passage for pumping up fuel from a second pump unit, in a fuel supply device, which includes a fuel pump having a first pump unit for supplying fuel in a sub tank to a fuel consumption device and the second pump unit for pumping up fuel outside the sub tank into the sub tank.

To achieve the objective of the present invention, there is provided a fuel supply device configured to supply fuel in a fuel tank to an external unit. The device includes a subtank, a fuel pump, and a filter member. The subtank is accommodated in the fuel tank, and the subtank stores a part of the fuel in the fuel tank. The fuel pump is accommodated in the subtank, and the fuel pump has a first pump unit, which is configured to suction fuel in the subtank thereby to supply fuel to the external unit, and a second pump unit, which is configured to suction fuel outside the subtank thereby to pump fuel into the subtank. The filter member is connected to a first suction port of the first pump unit and a second suction port of the second pump unit and is configured to filter the fuel supplied to the external unit and the fuel pumped into the subtank. The filter member includes a case, a first filter element, and a second filter element. The case has therein a partition wall, which defines a first flow passage and a second flow passage. The first flow passage directs the fuel in the subtank into the first suction port and the second flow passage directs the fuel outside the subtank into the second suction port. The first filter element is disposed in the first flow passage for filtering the fuel supplied to the external unit. The second filter element is disposed in the second flow passage for filtering the fuel pumped into the subtank.

This allows the filter member for fuel supply and the filter member for pumping-up to be united to form a single member. In consequence, the structure of the fuel supply device becomes simple, thus enabling a provision of the inexpensive fuel supply device.

The casing of the filter member may be mounted to a bottom surface of the sub tank in such a manner that a first inlet of the first flow passage is opened to the inside of the sub tank, and a second inlet of the second flow passage projects from the bottom surface of the sub tank to the outside and is opened toward a bottom surface of the fuel tank. According to this construction, since the first inlet is opened to the inside of the sub tank, the first flow passage can introduce the fuel in the sub tank to the first pump unit. Since the second inlet projects from the bottom surface of the sub tank to the outside and is opened toward the bottom surface of the fuel tank, the fuel in the fuel tank can be pumped up to the sub tank as much as possible.

An opening may be formed in the bottom surface of the sub tank and the casing of the filter member may be inserted and fixed into the opening. Since an assembly in a state of mounting the filter member to the fuel pump can be attached to the sub tank only by inserting the casing of the filter member into the opening from one direction, the man hour of assembling the fuel supply device is reduced, enabling a provision of the inexpensive fuel supply device.

A side wall of the casing may be provided with a flange formed therein having an outer diameter larger than the opening and contacting the bottom surface of the sub tank when the casing is inserted into the opening. Further, the first inlet may be formed closer to the sub tank than the flange and the second inlet may be formed closer to the outside of the sub tank than the flange. According to this construction, only by arranging the fuel pump, to which the filter member is attached, toward the bottom surface of the sub tank, positioning of the first and second inlets can be easily carried out.

The first filter element may be arranged in the first inlet and the second filter element may be arranged in the second inlet. According to this construction, since the first and second filter elements both are arranged in the first and second inlets, the

casing is always filled with the fuel which has passed through the filter. Thus, it can be restricted that foreign matter is accumulated in the casing.

A fuel passage for performing communication between an outside and an inside of a side wall in the second inlet may be formed in the side wall of the second inlet, and the second filter element may be arranged to cover the second inlet and the fuel passage.

According to this construction, the fuel passage is formed in the side wall of the second inlet and the second filter element is arranged to cover the second inlet and the fuel passage. Therefore, even if the fuel can not be pumped up from the second inlet due to the freezing of the water components, it is possible to pump up the fuel from the fuel passage arranged in the side wall of the second inlet.

To achieve the objective of the present invention, there is also provided a fuel supply device configured to supply fuel in a fuel tank to an external unit. The device includes a subtank, a fuel pump, and a filter member. The subtank is accommodated in the fuel tank, and the subtank stores a part of the fuel in the fuel tank. The fuel pump is accommodated in the subtank, and the fuel pump has a first pump unit, which is configured to suction fuel in the subtank thereby to supply fuel to the external unit, and a second pump unit, which is configured to suction fuel outside the subtank thereby to pump fuel into the subtank. The filter member is connected to a first suction port of the first pump unit for filtering the fuel supplied to the external unit, and is connected to a second suction port of the second pump unit for filtering the fuel pumped into the subtank. The filter member includes a case, a first filter element, and a second filter element. The case has therein a partition wall, which defines a first flow passage and a second flow passage. The first flow passage directs the fuel in the subtank into the first suction port, and the second flow passage directs the fuel outside the subtank into the second suction port through an opening formed on the subtank. The first filter element is disposed in the first flow passage for filtering the fuel supplied to the external unit. The second filter element is disposed to cover the opening for filtering the fuel pumped into the subtank.

This construction allows the filter member for fuel supply and the second flow passage in the filter member for pumping-up to be united to the single casing Therefore, by a simple construction of arranging the second filter element of the filter member for pumping-up to cover the opening, it is possible to filter the fuel for pumping-up. In consequence, the structure of the fuel supply device becomes simple, thus enabling a provision of the inexpensive fuel supply device.

The casing of the filter member may be mounted in the bottom surface of the sub tank in such a manner that a first inlet of the first flow passage is opened to the inside of the sub tank and a second inlet of the second flow passage projects from the bottom surface of the sub tank to the outside and is opened toward a bottom surface of the fuel tank. According to this construction, since the first inlet is opened to the inside of the sub tank, the first flow passage can introduce the fuel in the sub tank to the first pump unit. Since the second inlet projects from the bottom surface of the sub tank to the outside and is opened toward the bottom surface of the fuel tank, the fuel in the fuel tank can be pumped up to the sub tank as much as possible.

An opening may be formed in the bottom surface of the sub tank and the casing of the filter member may be inserted and fixed into the opening. Since an assembly in a state of mounting the filter member to the fuel pump can be attached to the sub tank only by inserting the casing of the filter member into the opening from one direction, the man hour of assembling the fuel supply device is reduced, enabling a provision of the inexpensive fuel supply device.

A side wall of the casing may be provided with a flange formed therein having an outer diameter larger than the opening and contacting the bottom surface of the sub tank when the casing is inserted into the opening. Further, the first inlet may be formed closer to the sub tank than the flange and the second inlet may be formed closer to the outside of the sub tank than the flange. According to this construction, only by arranging the fuel pump, to which the filter member is attached, toward the bottom surface of the sub tank, positioning of the first and second inlets can be easily carried out.

The first filter element may be arranged in the first inlet. According to this construction, since the first filter element is arranged in the first element and the second filter element is arranged to cover the opening, the casing is always filled with the fuel which has passed through the filter. Thus, it can be restricted that foreign matter is accumulated in the casing.

A fuel passage for performing communication between an outside and an inside of a side wall in the second inlet may be formed in the side wall of the second inlet.

According to this construction, the fuel passage is formed in the side wall of the second inlet and the second filter element is arranged to cover the opening. Therefore, even if the fuel can not be pumped up from the second inlet due to the freezing of the water component, it is possible to pump up the fuel which has passed through the filter from the fuel passage arranged in the side wall of the second inlet.

Furthermore, to achieve the objective of the present invention, there is provided a fuel supply device configured to supply fuel in a fuel tank to an external unit. The device includes a subtank, a fuel pump, and a filter member. The subtank is accommodated in the fuel tank, and the subtank stores a part of the fuel in the fuel tank. The fuel pump is accommodated in the subtank, and the fuel pump has a first pump unit, which is configured to suction fuel in the subtank thereby to supply fuel to the external unit, and a second pump unit, which is configured to suction fuel outside the subtank thereby to pump fuel into the subtank. The filter member is connected to a first suction port of the first pump unit for filtering the fuel supplied to the external unit, and is connected to a second suction port of the second pump unit for filtering the fuel pumped into the subtank. The filter member includes a case, a first filter element, and a second filter element. The case has therein a partition wall, which defines a first flow passage and a second flow passage. The first flow passage directs the fuel in the subtank into the first suction port, and the second flow passage directs the fuel outside the subtank into the second suction port through an opening formed on the subtank. The first filter element is configured to filter the fuel supplied to the external unit. The second filter element is disposed in the second flow passage for filtering the fuel pumped into the subtank. The second filter element is disposed such that a surface of the second filter element is generally parallel to an inner surface of the subtank, on which the opening is formed.

This construction allows the first flow passage of the filter member for fuel supply and the filter member for pumping-up to be united to the single casing. In consequence, the structure of the fuel supply device becomes simple, thus enabling a provision of the inexpensive fuel supply device.

Moreover, the second filter element is arranged in parallel with the inner surface of the sub tank in which the opening is formed. Therefore, it is possible to prevent a flow passage length of the second flow passage from being longer due to the arrangement of the second filter element, making it possible to shorten the flow passage length of the second flow

passage. That is, it is possible to shorten a flow passage length for pumping-up fuel from the second pump unit.

The first filter element may be arranged in the first flow passage. This allows the filter member for fuel supply and the filter member for pumping-up to be united to form a single member. In consequence, the structure of the fuel supply device becomes simple, thus enabling a provision of the inexpensive fuel supply device.

The first filter element may be arranged in parallel with the second filter element. Therefore, it is possible to prevent a length of the casing in the flow passage direction of the second flow passage from being longer due to the arrangement of the first filter element, making it possible to shorten the flow passage length of the second flow passage. That is, it is possible to shorten a flow passage length for pumping-up fuel from the second pump unit.

The first filter element and the second filter element each may be formed of a sheet-shaped element. Therefore, it is possible to further shorten the flow passage length of the second flow passage. That is, it is possible to further shorten a flow passage length for pumping-up fuel from the second pump unit.

The inner surface of the sub tank may be a bottom surface thereof and the casing of the filter member may be mounted to the bottom surface of the sub tank in such a manner that a first inlet of the first flow passage is opened to the inside of the sub tank, and a second inlet of the second flow passage projects from the bottom surface of the sub tank to the outside and is opened toward a bottom surface of the fuel tank. According to this construction, since the first inlet is opened to the inside of the sub tank, the first flow passage can introduce the fuel in the sub tank to the first pump unit. Since the second inlet projects from the bottom surface of the sub tank to the outside and is opened toward the bottom surface of the fuel tank, the fuel in the fuel tank can be pumped up to the sub tank as much as possible.

The casing of the filter member may be inserted and fixed into the opening. Since an assembly in a state of mounting the filter member to the fuel pump can be attached to the sub tank only by inserting the casing of the filter member into the opening from one direction, the man hour of assembling the fuel supply device is reduced, enabling a provision of the inexpensive fuel supply device.

A side wall of the casing may be provided with a flange formed therein having an outer diameter larger than the opening and contacting the bottom surface of the sub tank when the casing is inserted into the opening. Further, the first inlet may be formed closer to the sub tank than the flange and the second inlet may be formed closer to the outside of the sub tank than the flange. According to this construction, only by arranging the fuel pump, to which the filter member is attached, toward the bottom surface of the sub tank, positioning of the first and second inlets can be easily carried out.

The first filter element may be arranged in the first inlet and the second filter element may be arranged in the second inlet. According to this construction, since the first filter element and the second element are respectively provided in the first inlet and the second inlet, the casing is always filled with the fuel which has passed through the filter. Thus, it can be restricted that foreign matter is accumulated in the casing.

A fuel passage for performing communication between an outside and an inside of a side wall in the second inlet may be formed in the side wall of the second inlet, and the second filter element may be provided to cover the second inlet and the fuel passage.

According to this construction, the fuel passage is formed in the side wall of the second inlet and the second filter element is arranged to cover the second inlet and the fuel passage. Therefore, even if the fuel can not be pumped up from the second inlet due to the freezing of the water component, it is possible to pump up the fuel from the fuel passage arranged in the side wall of the second inlet.

The first suction port and the second suction port of the fuel pump may be formed in one end of the fuel pump, and a first outlet of the first flow passage connected to the first suction port and a second outlet of the second flow passage connected to the second suction port may be formed in an end facing the one end of the fuel pump.

According to this construction, only by moving the end, in which the first and second outlets are formed, toward one end in which the first and second suction ports of the fuel pump are formed, the connection between the suction port and the outlet can be easily made.

A check valve may be provided in the second flow passage for permitting only flow of the fuel from an outside to an inside of the sub tank. According to this construction, it is possible to restrict that the fuel pumped up in the sub tank flows out again through the second flow passage to the outside of the sub tank.

The check valve may be provided downstream of the second filter element. According to this construction, it is possible to restrict occurrence of functional degradation of the check valve due to the entering of the foreign matter contained in the fuel into a space between a valve body and a valve seat of the check valve.

The casing may comprise an upper casing including an upper partition wall and a lower casing including a lower partition wall to form the casing by being assembled with the upper casing. The upper partition wall and the lower partition wall may form a partition wall as a result of forming the casing by assembling the upper casing and the lower casing with each other to form the casing.

According to this construction, the upper partition wall is provided in the upper casing and the lower partition wall is provided in the lower casing to form the casing by assembling the upper casing and the lower casing. Thus the upper partition wall and the lower partition wall form the partition wall. With this construction, the single casing in which the first and second flow passages are formed by providing the partition wall inside the single casing can be of a simple structure. In consequence, the structure of the fuel supply device becomes simple, thus enabling a provision of the inexpensive fuel supply device.

The upper casing and the lower casing may be assembled with each other by press-fitting to form the casing. According to this construction, since the upper casing and the lower casing are assembled with each other by the press-fitting, the single casing in which the first and second flow passages are formed can be constructed more easily. In consequence, the structure of the fuel supply device becomes simple, thus enabling a provision of the inexpensive fuel supply device.

The second filter element may have a filter area larger than that of the first filter element.

According to this construction, since the second filter element has the filter area larger than that of the first filter element, it can be restricted that the filtering capability of the second filter element is more quickly degraded as compared to that of the first filter element.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, together with additional objectives, features and advantages thereof, will be best understood from the following description, the appended claims and the accompanying drawings in which:

FIG. **1** is a sectional view showing a fuel supply device according to a first embodiment of the invention;

FIG. **2** is a sectional view showing a filter assembly according to the first embodiment;

FIG. **3** is a diagram illustrating the filter assembly viewed from a direction III in FIG. **2**;

FIG. **4** is a cross section illustrating the filter assembly taken along a line IV-IV in FIG. **2**;

FIG. **5** is a sectional view showing a filter assembly according to a second embodiment of the invention;

FIG. **6** is a plan view showing a pumping-up fuel filter provided for the filter assembly in FIG. **5**;

FIG. **7** is a sectional view showing a filter assembly according to a third embodiment of the invention;

FIG. **8** is a plan view showing a pumping-up fuel filter provided for the filter assembly in FIG. **7**;

FIG. **9** is a sectional view showing a filter assembly according to a fourth embodiment of the invention;

FIG. **10** is a side view showing a main section of the filter assembly in FIG. **9**;

FIG. **11** is a sectional view showing a filter assembly according to a modification on the fourth embodiment;

FIG. **12** is a partial sectional view showing a fuel supply device according to a fifth embodiment of the invention;

FIG. **13** is a plan view showing a filter assembly according to the fifth embodiment;

FIG. **14** is a sectional view illustrating the filter assembly taken along a line XIV-XIV in FIG. **13**;

FIG. **15** is a diagram viewed from a direction XV in FIG. **13**;

FIG. **16** is a plan view showing a lower casing in FIG. **13**;

FIG. **17** is a plan view showing a filter assembly according to a sixth embodiment of the invention;

FIG. **18** is a sectional view illustrating the filter assembly taken along a line XVIII-XVIII in FIG. **17**;

FIG. **19** is a sectional view illustrating the filter assembly taken along a line XIX-XIX in FIG. **17**;

FIG. **20** is a sectional view showing a filter assembly according to a seventh embodiment of the invention;

FIG. **21** is a plan view showing a filter assembly according to an eighth embodiment of the invention;

FIG. **22** is a sectional view illustrating the filter assembly taken along a line XXII-XXII in FIG. **21**; and

FIG. **23** is a plan view showing a lower casing in FIG. **21**.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, plural embodiments of the present invention will be explained with reference with the drawings. It should be noted that in the following embodiments, components identical or equivalent to each other are referred to as identical codes in the drawings.

FIRST EMBODIMENT

FIG. **1** is a sectional view showing a state where a fuel supply device **1** is arranged in a fuel tank **2**. The upward-downward direction shown in an arrow in FIG. **1** shows the gravity direction in a state where the fuel tank **2** is mounted in a vehicle. The fuel supply device **1** is a device for supplying fuel in the fuel tank **2** to a fuel consumption device (for example, internal combustion engine). As shown in FIG. **1**, the fuel supply device **1** is inserted from an opening **21** of the fuel tank **2** into the fuel tank **2** to be arranged therein and is located on the bottom surface **22** of the fuel tank **2**. A flange **3** is attached on the opening **21** to close the opening **21** therewith.

The fuel supply device **1** is constructed by attaching a pump unit **5** and the like to a sub tank **4** accommodated in the fuel tank **2**. The sub tank **4** is jointed to the flange **3** with shafts **34**.

The flange **3** is made of a resin and is formed substantially in a disc-shape. The flange **3** is resin-molded integrally with a fuel discharge pipe **31** and an electric connector **32**. The fuel discharge pipe **31** is connected through a hose **33** to the pump unit **5** accommodated in the sub tank **4** and supplies the fuel discharged from the pump unit **5** to the internal combustion engine outside of the fuel tank **2**.

The electric connector **32** is electrically connected to an electric connector (not shown) provided in the pump unit **5** through a lead wire and a power supply connector (not shown) to supply the power to the pump unit **5**.

The sub tank **4** is made of a resin and includes a bottom surface **41** formed substantially in a disc shape and a side wall **42** extending upwards from an outer peripheral edge of the bottom surface **41**. The sub tank **4** accumulates a part of the fuel in the fuel tank **2**. The side wall **42** has an inner wall surface provided with insert portions (not shown) into which the shafts **34** that are fixed to an end of the flange **3** on the sub tank **4** side by press-fitting are inserted. The shafts **34** are inserted so as to be movable in an axial direction in the insert portions.

Coil springs **35** are provided between the flange **3** and the sub tank **4** for urging the sub tank **4** downwards to press down the sub tank **4** against the bottom surface **22** of the fuel tank **2**. The coil spring **35** has one end supported by the flange **3** and the other end supported by the insert portion of the sub tank **4**.

Accordingly, even if a distance between the opening **21** and the bottom surface **22** of the fuel tank **2** varies because the fuel tank **2** made of a resin expands or contracts due to a change in inner pressure by a temperature change or a change in fuel amount, the sub tank **4** can follow the position variation of the bottom surface **22**.

An opening **43** is formed on the bottom surface **41** of the sub tank **4**. A leg **44** extending toward the bottom surface **22** of the fuel tank **2** is formed in the circumference of the opening **43**. A filter assembly **7** as a filter member is inserted into the opening **43**.

The pump unit **5** is supported by the side wall **42** of the sub tank **4** through a support mechanism (not shown). The pump unit **5** includes a fuel pump **6**, a fuel filter **52**, a pressure regulator **67** and the filter assembly **7**. The fuel pump **6** includes a supply pump unit **65** as a first pump unit which suctions the fuel in the sub tank **4** and supplies the suctioned fuel to the internal combustion engine, a pumping unit **66** as a second pump unit which pumps up the fuel outside of the sub tank **4** to an inside of the sub tank **4**, and a electric motor **63** driving both of the pump units **65** and **66**.

Each of the supply pump unit **65** and the pumping unit **66** is provided with a flow passage formed therein. One vane is accommodated in each of the flow passages. The vane is formed in one impeller **64** having a disc shape and the impeller **64** is rotated by the electric motor **63**. When the impeller **64** is rotated, the fuel suctioned in the flow passage is increased in pressure.

A supply pump suction port **651** as a first suction port communicated with the flow passage of the supply pump unit **65** is formed in a lower end of the fuel pump **6**, and a pumping

suction port **661** as a second suction port communicated with the flow passage of the pumping unit **66** is formed in parallel with the supply pump suction port **651**. A pumping discharge port **662** for discharging the fuel pumped up by the pumping unit **66** to an inside of the sub tank **4** is formed in the lower end of the fuel pump **6** in addition to the two suction ports **651** and **661**. A supply pump discharge port **652** discharging the fuel pumped up by the supply pump unit **65** is formed in the upper end of the fuel pump **6**.

The filter assembly **7** is attached to the lower end of the fuel pump **6** for filtering the fuel suctioned from the supply pump suction port **651** and the pumping suction port **661**. When the impeller **64** is rotated by operating the electric motor **63**, suction forces are generated in the supply pump unit **65** and the pumping unit **66**. Then, the fuel outside of the sub tank **4** is suctioned through the filter assembly **7** into the supply pump suction port **651** and the fuel outside of the sub tank **4** is suctioned through the filter assembly **7** into the pumping suction port **661**.

The fuel suctioned from the supply pump suction port **651** is discharged from the supply pump discharge port **652** and is supplied to the fuel filter **52**. The fuel suctioned from the pumping suction port **661** is discharged from the pumping discharge port **662** and is supplied to the inside of the sub tank **4**.

The filter casing **51** accommodates therein the fuel filter **52** for filtering the fuel discharged from the supply pump discharge port **652**. The filter casing **51** is made of a resin and has a space having a substantially annular shape for accommodating the fuel filter **52**. The filter casing **51** is constructed to have a space further on the inner peripheral side from the substantially annular space for accommodating the fuel pump **6**. The upper end of the filter casing **51** has a connection portion connected to the supply pump discharge port **652**. The connection portion and the space having the substantially annular shape are communicated through the fuel passage and the fuel discharged from the supply pump discharge port **652** is supplied to the fuel filter **52**.

A pressure regulator **67** is provided in the lower end of the filter casing **51** more specifically in the lower end of the substantially annular space. The pressure regulator **67** adjusts a pressure of the fuel which has passed through the fuel filter **52**. The fuel, pressure of which is adjusted at the pressure regulator **67**, is discharged from a discharge port **68** formed in the filter casing **51**. The fuel discharged from the discharge port **68** is supplied to the internal combustion engine outside of the fuel tank **2** through the hose **33** and the fuel discharge pipe **31**. When a pressure of the fuel discharged from the fuel pump **6** is more than a predetermined value, the extra pressure-fuel flows out from a drain port (not shown) of the pressure regulator **67** and is returned to the inside of the sub tank **4**.

Next, the filter assembly **7** will be explained with reference to FIGS. **2** to **4**.

The filter assembly **7** is connected to the fuel pump **6** and filters the fuel suctioned by the supply pump unit **65** and the fuel suctioned by the pumping unit **66** of the fuel pump **6** with a single component.

The filter assembly **7** is made of a resin and, as shown in FIG. **2**, has an upper casing **8** and a lower casing **9**. The lower casing **9** includes a cylindrical portion **91** whose ends in the upward-downward direction are opened, and a first partition wall **93** for partitioning the cylindrical portion **91** into upper and lower portions is formed substantially near the central portion of the cylindrical portion **91**. A flange **96** extending in the outer peripheral direction of the cylindrical portion **91** is formed on the outer wall surface substantially near the central portion of the cylindrical portion **91**.

The cylindrical portion **91** on a lower side from the flange **96** can be inserted into the opening **43** formed in the bottom surface **41** of the sub tank **4**. A groove portion **97** is formed on the outer wall surface of the cylindrical portion **91** contacting the opening **43**. An O-ring **98** is attached to the groove portion **97** for securing sealing properties between the cylindrical portion **91** and the opening **43**.

The lower opening **92** on the lower side of the cylindrical portion **91** projects outside from the bottom surface **41** and is opened toward the bottom surface **22** of the fuel tank **2** when the lower casing **9** is inserted into the opening **43** of the sub tank **4**. A pumping-up fuel filter **99** as the second filter element is provided in the opening **43**. The pumping-up fuel filter **99** is formed in a sheet shape, for example, of substantially disc-shaped non-woven cloth and is jointed to the outer peripheral edge of the lower opening **92** by welding. The pumping-up fuel filter **99** is arranged substantially in parallel with the bottom surface **41** of the sub tank **4** in which the opening **43** is formed.

The pumping-up fuel filter **99** is made by fiberizing a resin such as polyester, nylon, polypropylene or acetylene. Since such a material has a relatively high durability against the fuel, a lifetime of the filter assembly **7** can be lengthened by using the material as the pumping-up fuel filter **99**.

As shown in FIGS. **2** and **4**, a projection **94** is formed on an upper surface of the first partition wall **93** for partitioning the upper surface into a left surface and a right surface. In FIGS. **2** and **4**, through bores **95** penetrating the first partition wall **93** are formed in parallel in the circumference direction in the right surface from the projection **94**. A check valve **100** permitting only the flow of the fuel from the lower side toward the upper side of the cylindrical portion **91** is further provided on the right surface.

The check valve **100** is, as shown in FIG. **2**, formed in an umbrella shape and is configured in such a manner that a portion of the check valve **100** corresponding to a handle of the umbrella is inserted into a bore of the first partition wall **93** and a portion thereof corresponding to an outer peripheral portion of the umbrella is in contact with the upper surface of the first partition wall **93**. Accordingly, the through bores **95** are closed.

When a fuel pressure on a lower side of the through bore **95** is higher than that on an upper side thereof, the check valve **100** is detached from the upper surface of the first partition wall **93** and fuel on a lower side of the first partition wall **93** flows into the upper side through the through bore **95**.

The upper casing **8** is formed to close an upper opening of the cylindrical portion **91** in the lower casing **9**. A second partition wall **82** extending toward the projection **94** of the first partition wall **93** is formed on a surface of the upper end **81** of the upper casing **8** opposed to the first partition wall **93** (see a broken line in FIG. **3**). By attaching the upper casing **8** to the lower casing **9**, as shown in FIG. **2**, two spaces are defined by the upper end **81** of the upper casing **8** and the first partition wall **93** of the lower casing **9**. The second partition wall **82** corresponds to an upper partition wall, the projection **94** corresponds to a lower partition wall and the second partition wall **82** and the projection **94** correspond to a partition wall.

An upper opening **83** communicating with a left space in FIG. **2** is formed in the upper end **81**. A supply fuel filter **86** as the first filter element is provided in the opening **83**. The supply fuel filter **86** is also formed in a sheet shape in the same way as the pumping-up fuel filter **99** and is arranged substantially in parallel with the pumping-up fuel filter **99**. It should

be noted that a filter area of the pumping-up fuel filter **99** is set larger than that of the supply fuel filter **86**. That is, as shown in FIGS. **2** and **3**, a size of the pumping-up fuel filter **99** is set larger than that of the supply fuel filter **86**.

The supply fuel filter **86** is formed of non-woven cloth made of the same material as the pumping-up fuel filter **99**. The supply fuel filter **86** is jointed to the upper opening **83** by welding or insert molding.

A first connection portion **84** communicating with the left space in FIG. **2** is formed on the upper portion **81**. The first connection portion **84** is connected to the supply pump suction port **651** of the fuel pump **6**. A second connection portion **85** communicating with the right space in FIG. **2** is formed on the upper end **81**. The second connection portion **85** is connected to the pumping suction port **661** of the fuel pump **6**.

When the upper casing **8** and the lower casing **9** having the above configuration are assembled, two flow passages are formed in the filter assembly **7**. One of them is a supply fuel flow passage **71** as a first flow passage having a first inlet as the upper opening **83** and a first outlet as the first connection portion **84**. The other is a pumping-up fuel flow passage **72** as a second flow passage having a second inlet as the lower opening **92** and a second outlet as the second connection portion **85**.

Next, a flow of the fuel in the filter assembly **7** generated at the time the fuel pump **6** operates will be explained.

When the fuel pump **6** is activated, suction forces are generated in the supply pump unit **65** and the pumping unit **66**. Then, the fuel in the sub tank **4** flows through the supply fuel filter **86** from the upper opening **83** to the supply fuel flow passage **71**. The fuel flowing into the supply fuel flow passage **71** is suctioned through the first connection portion **84** into the supply pump suction port **651** of the fuel pump **6**.

The fuel outside of the sub tank **4** passes through the opening **43** formed in the sub tank **4** and flows through the pumping-up fuel filter **99** from the lower opening **92** into the pumping-up fuel passage **72**. The fuel flowing into the pumping-up fuel flow passage **72** passes through the through bore **95** and is suctioned into the pumping suction port **661** of the fuel pump **6** through the second connection portion **85**. That is, it should be understood that the pumping-up fuel flow passage **72** is a flow passage for introducing the fuel outside of the sub tank **4** (in the fuel tank **2**) through the opening **43** formed in the sub tank **4** to the pumping suction port **661**.

In the present embodiment, unlike the conventional art, the first and second partition walls **93** and **82** and the projection **94** are provided inside the single casing (in a state where the upper casing **8** and the lower casing **9** are assembled) to form the two flow passages (supply fuel flow passage **71** and pumping-up fuel flow passage **72**). Further, the filter assembly **7**, in which the supply fuel filter **86** and the pumping-up fuel filter **99** are provided to the flow passages **71** and **72** respectively, is connected to the fuel pump **6**.

In consequence, as compared to a case where one filter member is provided to each of the suction ports formed in the fuel pump as in the case of the conventional one, the structure of the fuel supply device **1** can be simplified. As a result, the inexpensive fuel supply device can be provided.

In the present embodiment, the second partition wall **82** is provided in the upper casing **8**, the projection **94** is provided in the lower casing **9**, and the upper casing **8** and the lower casing **9** are attached to each other to form one casing. Thereby, the second partition wall **82** and the projection **94** are configured to form the partition wall. With such a construction, one casing in which the supply fuel flow passage **71** and the pumping-up fuel flow passage **72** are formed by providing the partition wall therein can have a simple structure. In consequence, the structure of the fuel supply device **1** can be simplified and the inexpensive fuel supply device can be provided.

In the present embodiment, the first and second connection portions **84** and **85** are formed in parallel on the upper end **81** of the filter assembly **7**. Therefore, in a case where the supply pump suction port **651** and the pumping suction port **661** are formed in parallel at one end of the fuel pump **6**, only by moving the filter assembly **7** toward both of the suction ports **651** and **661**, both of the connection portions **84** and **85** can be easily connected to both of the suction ports **651** and **661**.

Further, since the fitter assembly **7** is fixed by being inserted into the opening **43** formed in the sub tank **4**, only by inserting the pump unit **5** in a state where the filter assembly **7** is attached to the end of the fuel pump **6** from the opening side of the sub tank **4**, the pump unit **5** can be easily attached to the sub tank **4**.

The filter assembly **7** has the flange **96** and is provided with the upper opening **83**, which is formed on the upper side of the flange **96** and into which the fuel in the sub tank **4** flows, and the lower opening **92**, which is formed on the lower side of the flange **96** and into which the fuel outside of the sub tank **4** flows. Therefore, at the time of attaching the filter assembly **7** to the opening **43** of the sub tank **4**, only by inserting the flange **96** until the flange **96** contacts the bottom surface of the sub tank **4**, both of the openings **83** and **92** can be arranged at an appropriate position.

The check valve **100** is provided in the midst of the pumping-up fuel flow passage **72** for permitting only the flow of the fuel from the lower opening **92** to the second connection portion **85**. Therefore, it can be restricted that the fuel pumped up into the sub tank **4** flows back and flows out of the sub tank **4**.

Since the check valve **100** is provided downstream of the pumping-up fuel filter **99**, it can restrict the functional degradation of the check valve **100** caused because the foreign matter is sandwiched between the check valve **100** and the first partition wall **93**.

In the present embodiment, the supply fuel filter **86** is provided in the upper opening **83** and the pumping-up fuel filter **99** is provided in the lower opening **92**. Therefore, the filter assembly **7** is filled with the fuel which has always passed both of the filters **86** and **99** and thereby, it can be restricted that the foreign matter in the fuel is accumulated in the filter assembly **7**.

Since the lower opening **92** extends outside from the bottom surface **41** of the sub tank **4** and is opened toward the bottom surface **22** of the fuel tank **2**, the fuel in the fuel tank **2** can be pumped up into the sub tank **4** as much as possible.

It should be noted that the second partition wall **82** and the projection **94** may be jointed by an adhesive or the like, but if the pressure loss generated when the fuel passes through a clearance between the second partition wall **82** and the projection **94** is larger than that when the fuel passes through a clearance between the check valve **100** and the first partition wall **93**, the second partition wall **82** and the projection **94** may be arranged to be contacted with each other without use of an adhesive or the like, since the outflow of the fuel in the supply fuel flow passage **71** into the pumping-up fuel flow passage **72** through the clearance is restricted.

In FIG. **2**, when the pumping-up fuel filter **99** is arranged to be inclined with respect to the bottom surface **41**, the flow passage length of the fuel flow passage **72** is made long. Therefore, a high suction force is required in the pumping unit **66**. In contrast, in the present embodiment, since the pumping-up fuel filter **99** is arranged substantially in parallel with the bottom surface **41** of the sub tank **4** in which the opening

43 is formed, it can be restricted that the flow passage length of the fuel passage **72** is made longer due to the arrangement of the pumping-up fuel filter **99**. That is, since it is possible to shorten the length of the flow passage for pumping-up fuel from the pumping unit **66**, it can be restricted that the high suction force is required in the pumping unit **66**.

In FIG. **2**, when the supply fuel filter **86** is arranged to be inclined with respect to the pumping-up fuel filter **99** arranged substantially in parallel with the bottom surface **411** in the flow passage direction (upward-downward direction in FIG. **2**) of the pumping-up fuel flow passage **72**, a length of the casing including the upper casing **8** and the lower casing **9** is made long. In contrast, in the present embodiment, the supply fuel filter **86** is arranged to be substantially in parallel with the pumping-up fuel filter **99** arranged substantially in parallel with the bottom surface **41**. Therefore, it can be restricted that in the flow passage direction of the pumping-up fuel flow passage **72**, the length of the casing including the upper casing **8** and the lower casing **9** is made long due to the arrangement of the supply fuel filter **86**. Therefore, the flow passage length of the fuel passage **72** is made shorter. That is, since it is possible to shorten the length of the flow passage for pumping-up fuel from the pumping unit **66**, it can be restricted that the high suction force is required in the pumping unit **66**.

Since the supply fuel filter **86** and the pumping-up fuel filter **99** are not pouched filters but sheet-shaped filters, the flow passage length of the pumping-up fuel passage **72** can be made shorter That is, since it is possible to further shorten the length of the flow passage for pumping-up fuel from the pumping unit **66**, it can be restricted that the high suction force is required in the pumping unit **66**.

Since the fuel is filtered through the supply fuel filter **86** after being filtered through the pumping-up fuel filter **99**, filtered substances tend to be more easily accumulated in the pumping-up fuel filter **99** as compared to the supply fuel filter **86**. Therefore, the filtering capability of the pumping-up fuel filter **99** may be more quickly degraded as compared to that of the supply fuel filter **86**.

In the present embodiment, since the pumping-up fuel filter **99** has the filter area larger than that of the supply fuel filter **86**, it can be restricted that the filtering capability of the pumping-up fuel filter **99** is more quickly degraded as compared to that of the supply fuel filter **86**.

SECOND EMBODIMENT

A second embodiment of the present invention will be explained with reference to FIGS. **5** and **6**.

As shown in FIGS. **5** and **6**, a pumping-up fuel filter **99***a* is configured as a result of providing a filter body **992**, which is made of non-woven cloth similar to the first embodiment, for a substantially annular ring member **991**. The pumping-up fuel filter **99***a* of the present embodiment is fixed by press-fitting the ring member **991** into an inner wall of the cylindrical portion **91** in the lower casing **9**. In consequence, the pumping-up fuel filter **99***a* can be easily mounted to the filter assembly **7**.

THIRD EMBODIMENT

A third embodiment of the present invention will be explained with reference to FIGS. **7** and **8**.

As shown in FIGS. **7** and **8**, a pumping-up fuel filter **99***b* includes a substantially annular ring member **993**, a disc member **994** arranged substantially in the center of the ring member **993**, and hub members **995** connecting the ring member **993** to the disc member **994**. Filter bodies **996** made of non-woven cloth as in the case of the first embodiment are provided in spaces between the ring member **993** and the disc member **994**. The pumping-up fuel filter **99***b* of the present embodiment is fixed by press-fitting the ring member **993** into the inner wall of the cylindrical portion **91** in the lower casing **9**. In consequence, the pumping-up fuel filter **99***b* can be easily mounted to the filter assembly **7**.

The pumping-up fuel filter **99***b* of the present embodiment is configured to support the filter body **996** by the disc member **994** provided in the substantially central portion and the hub member **995**. Therefore, the strength of the filter **99***b* is improved.

FOURTH EMBODIMENT

A fourth embodiment of the present invention will be explained with reference to FIGS. **9** and **10**.

As shown in FIG. **9**, a substantially annular projection **91***a* is formed in the flange **96** of the lower casing **9** on an outer peripheral side from the cylindrical portion **91**. The projection **91***a* is supported by the opening **43** of the sub tank **4**.

As shown in FIG. **10**, grooves **91***b* are formed on the side wall near the lower opening **92** of the cylindrical portion **91** for establishing communication between the outer wall and the inner wall of the cylindrical portion **91**. The groove **91***b* corresponds to a fuel passage.

A pumping-up fuel filter **99***c* provided on the lower opening **92** is, as shown in FIG. **9**, provided to cover the grooves **91***b*. The pumping-up fuel filter **99***c* has an end which is fixed using a plastic ring **997**.

Since the water component contained in the fuel has a specific gravity larger than that of the fuel, the water component tends to easily remain in the bottom surface **22** of the fuel tank **2**. If the lower opening **92** is opened toward the bottom surface **22** of the fuel tank **2** as in the cases from the first to third embodiments, the fuel may not be suctioned from the lower opening **92** when the water component which has remained on the bottom surface **22** is frozen.

In the filter assembly **7** of the present embodiment, the grooves **91***b* are formed on the side wall of the cylindrical portion **91**. Therefore, even if the fuel can not be suctioned from the lower opening **92**, the fuel can be suctioned through the grooves **91***b*.

As shown in FIG. **11**, instead of the groove **91***b* shown in FIG. **10**, through bores **91***c* may be formed on the side wall of the cylindrical portion **91** and filters **998** different from the pumping-up fuel filter **99** in the lower opening **92** may be provided in the through bores **91***c*.

FIFTH EMBODIMENT

A fifth embodiment of the present invention will be explained with reference to FIGS. **12** and **16**.

In the present embodiment, arm portions **60** in which engaged holes **601** are formed in the lower end of the fuel pump **6**, and engagement pawls **701**P engaging the engaged holes **601** are formed in a filter assembly **7**P. By engaging the engagement nail **701**P and the engaged hole **601**, the connection between connection portions **84**P, **85**P of the filter assembly **7**P (FIG. **14**) and the suction ports **651**, **661** of the fuel pump **6** can be secured. The engagement pawls **701**P are formed on a lower casing **9**P as shown in FIGS. **13** to **15**.

The filter assembly **7**P is, as shown in FIG. **14**, provided with a casing **70**P, a supply fuel filter **86**P, a pumping-up fuel filter **99**P and the check valve **100**. The filter assembly **7**P is fixed to the sub tank **4** by press-fitting a cylindrical portion

91P into the opening 43 of the sub tank 4. Along with abolishment of the groove 97 and the O-ring 98, the sealing properties between the cylindrical portion 91P and the opening 43 is secured by the press-fitting.

The casing 70P is formed by press-fitting an upper casing 8P into a lower casing 9P. The sealing properties between the upper casing 8P and the lower casing 9P are secured by the press-fitting. It should be noted that, unlike the cases 8 and 9 of the above embodiments, the upper casing 8P is attached into the lower casing 9P, since the engagement pawl 701P is formed on the lower casing 9P in the present embodiment. A flange 96P is formed on the lower casing 9P.

In the present embodiment, a second partition wall 82P is provided in the upper casing 8P, the projection 94P is provided in the lower casing 9P, and the upper casing 8P and the lower casing 9P are attached to each other to form a casing 70P. Thereby, the second partition wall 82P and the projection 94P form a partition wall 702P. The second partition wall 82P is fitted into the projection 94P, thereby forming the partition wall 702P.

The projection 94P is formed in a shape shown in FIG. 16 and the second partition wall 82P is also formed in a shape similar to the projection 94P (not shown). As shown in FIG. 16, the lower casing 9P is divided by the projection 94P to form a supply fuel flow passage 71P and a pumping-up fuel flow passage 72P therein. The upper casing 8P is divided by the second partition wall 82P formed in a shape similar to the projection 94P to form the supply fuel flow passage 71P and the pumping-up fuel flow passage 72P therein (not shown).

With such a construction, one casing 70P in which the supply fuel flow passage 71P and the pumping-up fuel flow passage 72P are formed by providing the partition wall 702P therein can have a simple structure. In consequence, the structure of the fuel supply device 1 can be simplified and the inexpensive fuel supply device can be provided.

A pumping-up fuel filter 99P is configured as a result of providing a filter body 992P made of non-woven cloth similar to the first embodiment for a substantially annular ring member 991P like the pumping-up fuel filter 99*a* of the second embodiment. The pumping-up fuel filter 99P of the present embodiment is fixed by press-fitting the ring member 991P into an inner wall (lower opening 92P) of the cylindrical portion 91P in the lower casing 9P. In consequence, the pumping-up fuel filter 99P can be easily mounted to the filter assembly 70P.

The supply fuel filter 86P is also a non-woven cloth made of a material similar to that of the pumping-up fuel filter 99P and, for example, is jointed to the upper opening 83P by welding. It should be noted that the upper opening 83P shown in FIG. 13 is made larger as compared to the upper opening 83 shown in FIG. 3. The upper opening 83P is maximized in size in the supply fuel flow passage 71P and thereby the filter area of the supply fuel filter 86P is made large. By increasing the filter area of the supply fuel filter 86P, a filter lifetime of the supply fuel filter 86P can be lengthened.

SIXTH EMBODIMENT

A sixth embodiment of the present invention will be explained with reference to FIGS. 17 and 19.

In a filter assembly 7Q of the present embodiment, a supply fuel filter 86Q is a non-woven cloth made of a material similar to that of the filter 86, 99, 86P or 99P, and is jointed at an upper opening 83Q to an upper casing 8Q by insert molding. In a casing 70Q, three notch portions 831Q are provided in the upper opening 83Q of the upper casing 8Q and three notch portions 97Q are provided in a side wall of a lower casing 9Q. In consequence, the supply fuel filter 86Q is exposed from the casing 70Q through the notch portions 831Q and 97Q.

Even if a liquid surface level of the fuel is lowered to reach level FL as shown in FIG. 18, a part of the supply fuel filter 86Q which is exposed through the notch portions 831Q and 97Q can filter the fuel of level FL, so that the filtered fuel can be supplied to the fuel consumption device. It should be noted that, as shown in FIG. 19, a part of the supply fuel filter 86Q which is not exposed through the notch portions 831Q and 97Q can not filter the fuel of level FL, so that the filtered fuel can not be supplied to the fuel consumption device. However, since the part of the supply fuel filter 86Q which are not exposed through the notch portions 831Q and 97Q is surrounded by the upper casing 8Q, the supply fuel filter 86Q is strongly jointed to the upper casing 8Q.

SEVENTH EMBODIMENT

A seventh embodiment of the present invention will be explained with reference to FIG. 20.

In a filter assembly 7R of the present embodiment, a pumping-up fuel filter 99R is not united to a casing 70R and is provided to cover the opening 43 of a sub tank 4R.

The filter assembly 7R is, as shown in FIG. 20, provided with the casing 70R, the supply fuel filter 86P and the check valve 100. The filter assembly 7R is fixed to the sub tank 4R by press-fitting a cylindrical portion 91R into the opening 43 of the sub tank 4R. Along with abolishment of the groove 97 and the O-ring 98, the sealing properties between the cylindrical portion 91R and the opening 43 are secured by the press-fitting. It should be noted that, in the present embodiment, the filter member includes the filter assembly 7R and the pumping-up fuel filter 99R.

The casing 70R is formed by press-fitting the upper casing 8P into the lower casing 9R. The sealing properties between the upper casing 8P and the lower casing 9R are secured by the press-fitting. In the present embodiment, the second partition wall 82P is provided in the upper casing 8P, the projection 94P is provided in the lower casing 9R, and the upper casing 8P and the lower casing 9R are attached to each other to form the casing 70R. Thereby, the second partition wall 82P and the projection 94P form the partition wall 702P.

Flow passages 71P and 72R are formed by the partition wall 702P. The pumping-up fuel flow passage 72R is formed in a route from the lower opening 92R via the through bore 95 and the check valve 100 to the second connection portion 85P and introduces the fuel outside of the sub tank 4R (in the fuel tank 2) to the pumping suction port 661 through the opening 43 formed in the sub tank 4R.

The pumping-up fuel filter 99R is a fuel filter having a diameter larger than that of each of the pumping-up fuel filters 99*a* and 99P and is configured as a result of providing a filter body 992R made of non-woven cloth similar to that of the filter bodies 992 and 992P to a substantially annular ring member 991R. The pumping-up fuel filter 99R is not united to the casing 70R and is provided to cover the opening 43 of the sub tank 4R. More specifically, the pumping-up fuel filter 99R is fixed by press-fitting the ring member 991R into an inner wall of a cylindrical portion 44R in the sub tank 4R and is mounted to the sub tank 4R to cover the opening 43.

The supply fuel filter 86P is a non-woven cloth made of a material similar to that of the filter 86, 99, 86P, 99P or 99R and is jointed to the upper opening 83P by insert molding.

In the present embodiment, by providing the partition wall 702P inside the single casing 70R, the two flow passages of the supply fuel flow passage 71P introducing the fuel in the sub tank 4R to the supply pump suction port 651 and the

pumping-up fuel flow passage **72**R pumping up the fuel outside of the sub tank **4**R through the opening **43** of the sub tank **4**R and introducing the fuel to the pumping-up pump suction port **661** are formed. Further, the supply fuel filter **86**P for filtering the fuel for supply is arranged in the supply fuel flow passage **71**P, and the pumping-up fuel filter **99**R for filtering the fuel to be pumped-up is provided to cover the opening **43**.

This construction allows the filter member for fuel supply (supply fuel flow passage **71**P and supply fuel filter **86**P) and the pumping-up fuel flow passage **72**R of the filter member for pumping-up to be united into the single casing **70**R. Therefore, it is possible to filter the fuel to be pumped-up by a simple structure of providing the pumping-up fuel filter **99**R of the filter member for pumping-up to cover the opening **43**. In consequence, the structure of the fuel supply device becomes simple, thus enabling a provision of the inexpensive fuel supply device **1**.

It should be noted that as compared to a diameter of each of the pumping-up fuel filters **99***a* and **99**P, a diameter of the pumping-up fuel filter **99**R is made larger and a filter area of the pumping-up fuel filter **99**R is made larger. This allows a filter lifetime of the pumping-up fuel filter **99**R to be lengthened.

EIGHTH EMBODIMENT

An eighth embodiment of the present invention will be explained with reference to FIGS. **21** to **23**.

A filter assembly **7**S of the present embodiment is provided with an extending portion **73**S extending toward the left side, an upper opening **83**S enlarged to the extending portion **73**S, and a supply fuel filter **86**S enlarged to the extending portion **73**S.

The filter assembly **7**S is, as shown in FIG. **22**, provided with a casing **70**S, the supply fuel filter **86**S and the pumping-up fuel filter **99**R The filter assembly **7**S is fixed to the sub tank **4** by press-fitting the cylindrical portion **91**P into the opening **43** of the sub tank **4**. The casing **70**S is formed by press-fitting an upper casing **8**S into a lower casing **9**S. In the present embodiment, a second partition wall **82**S is provided in the upper casing **8**S, a projection **94**S is provided in the lower casing **9**S, and the upper casing **8**S and the lower casing **9**S are attached to each other to form the casing **70**S. Thereby, the second partition wall **82**S and the projection **94**S form the partition wall **702**S.

The projection **94**S is formed in a shape shown in FIG. **23** and the second partition wall **82**S is also formed in a shape similar to the projection **94**S (not shown). As shown in FIG. **23**, the lower casing **9**S is provided with an extending portion **98**S corresponding to the extending portion **73**S and is divided by the projection **94**S to form a supply fuel flow passage **71**S and a pumping-up fuel flow passage **72**S therein. The upper casing **8**S is provided with an extending portion corresponding to the extending portion **73**S and is divided by the second partition wall **82**S, which is formed in a shape similar to the projection **94**S, to form the supply fuel flow passage **71**S and the pumping-up fuel flow passage **72**S therein (not shown).

The supply fuel filter **86**S is a non-woven cloth made of a material similar to that of the fuel filter **86**, **86**P, **99** or **99**P and is jointed to the upper opening **83**S by welding, for example. As described above, the upper opening **83**S shown in FIGS. **21** and **22** is extended and enlarged to the extending portion **73**S. In consequence, the supply fuel filter **86**S is made large to enlarge a filter area of the supply fuel filter **86**S. Therefore, it is possible to lengthen the filter lifetime of the supply fuel filter **86**S.

It should be noted that instead of the filter assembly **7**S provided with the extending portion **73**S, by forming the filter assembly in another irregular shape, the filter area of the supply fuel filter **86**S can be increased.

Additional advantages and modifications will readily occur to those skilled in the art. The invention in its broader terms is therefore not limited to the specific details, representative apparatus, and illustrative examples shown and described.

What is claimed is:

1. A fuel supply device configured to supply fuel in a fuel tank to an external unit, the device comprising:

a subtank accommodated in the fuel tank, the subtank storing a part of the fuel in the fuel tank;

a fuel pump accommodated in the subtank, the fuel pump having a first pump unit, which is configured to suction fuel in the subtank thereby to supply fuel to the external unit, and a second pump unit, which is configured to suction fuel outside the subtank thereby to pump fuel into the subtank; and

a filter member that is connected to a first suction port of the first pump unit and a second suction port of the second pump unit and that is configured to filter the fuel supplied to the external unit and the fuel pumped into the subtank, wherein the filter member includes:

a case having therein a partition wall, which defines a first flow passage and a second flow passage, wherein the first flow passage directs the fuel in the subtank into the first suction port and the second flow passage directs the fuel outside the subtank into the second suction port;

a first filter element disposed in the first flow passage for filtering the fuel supplied to the external unit; and

a second filter element disposed in the second flow passage for filtering the fuel pumped into the subtank.

2. The fuel supply device according to claim **1**, wherein the case is attached on a bottom surface of the subtank such that:

a first inlet of the first flow passage opens into the subtank; and

a second inlet of the second flow passage projects from the bottom surface of the subtank into an outside of the subtank, and opens toward a bottom surface of the fuel tank.

3. The fuel supply device according to claim **2**, wherein:

the subtank has an opening on the bottom surface of the subtank; and

the case is inserted into the opening so as to be fixed to the subtank.

4. The fuel supply device according to claim **3**, wherein:

the case has a flanged portion on a sidewall thereof, and an outer diameter of the flanged portion is larger than an outer diameter of the opening of the subtank; and

the flanged portion is formed between the first inlet and the second inlet in a thickness direction of the flanged portion, and is brought into contact with the bottom surface of the subtank when the case is inserted into the opening.

5. The fuel supply device according to claim **2**, wherein the first filter element is disposed in the first inlet, and the second filter element is disposed in the second inlet.

6. The fuel supply device according to claim **5**, wherein:

the second inlet has a fuel passage on a sidewall thereof, and an outside and an inside of the sidewall of the second inlet communicate through the fuel passage; and

the second filter element is disposed to cover the second inlet and the fuel passage.

7. The fuel supply device according to claim 1, wherein:
the first suction port and the second suction port of the fuel pump are formed at one end portion of the fuel pump;
a first outlet of the first flow passage that is connected to the first suction port and a second outlet of the second flow passage that is connected to the second suction port are formed at an end portion of the case; and
the end portion of the case is opposed to the one end portion of the fuel pump.

8. The fuel supply device according to claim 1, further comprising a check valve disposed in the second flow passage, wherein the check valve allows only a flow of fuel from an outside into an inside of the subtank.

9. The fuel supply device according to claim 8, wherein the check valve is disposed on a downstream side of the second filter element in a flow direction of fuel.

10. The fuel supply device according to claim 1 wherein:
the case includes an upper casing, which has an upper partition wall, and a lower casing, which has a lower partition wall and is attached to the upper casing; and
the upper partition wall and the lower partition wall constitute the partition wall when the upper casing and the lower casing are attached to each other to form the case.

11. The fuel supply device according to claim 10, wherein the upper casing and the lower casing are attached to each other by press fitting to form the case.

12. The fuel supply device according to claim 1, wherein a filtration area of the second filter element is larger than a filtration area of the first filter element.

13. A fuel supply device configured to supply fuel in a fuel tank to an external unit, the device comprising:
a subtank accommodated in the fuel tank, the subtank storing a part of the fuel in the fuel tank;
a fuel pump accommodated in the subtank, the fuel pump having a first pump unit, which is configured to suction fuel in the subtank thereby to supply fuel to the external unit, and a second pump unit, which is configured to suction fuel outside the subtank thereby to pump fuel into the subtank; and
a filter member that is connected to a first suction port of the first pump unit for filtering the fuel supplied to the external unit and that is connected to a second suction port of the second pump unit for filtering the fuel pumped into the subtank, wherein the filter member includes:
a case having therein a partition wall, which defines a first flow passage and a second flow passage, wherein the first flow passage directs the fuel in the subtank into the first suction port and the second flow passage directs the fuel outside the subtank into the second suction port through an opening formed on the subtank;
a first filter element disposed in the first flow passage for filtering the fuel supplied to the external unit; and
a second filter element disposed to cover the opening for filtering the fuel pumped into the subtank.

14. The fuel supply device according to claim 13, wherein the case is attached on a bottom surface of the subtank such that:
a first inlet of the first flow passage opens into the subtank; and
a second inlet of the second flow passage projects from the bottom surface of the subtank into an outside of the subtank, and opens toward a bottom surface of the fuel tank.

15. The fuel supply device according to claim 14, wherein:
the opening of the subtank is formed on the bottom surface of the subtank; and
the case of the filter member is inserted into the opening so as to be fixed to the subtank.

16. The fuel supply device according to claim 15, wherein:
the case has a flanged portion on a sidewall thereof, and an outer diameter of the flanged portion is larger than an outer diameter of the opening of the subtank; and
the flanged portion is formed between the first inlet and the second inlet in a thickness direction of the flanged portion, and is brought into contact with the bottom surface of the subtank when the case is inserted into the opening.

17. The fuel supply device according to claim 14, wherein the first filter element is disposed in the first inlet.

18. The fuel supply device according to claim 17, wherein the second inlet has a fuel passage on a sidewall thereof, and an outside and an inside of the sidewall of the second inlet communicate through the fuel passage.

19. The fuel supply device according to claim 13, wherein:
the first suction port and the second suction port of the fuel pump are formed at one end portion of the fuel pump;
a first outlet of the first flow passage that is connected to the first suction port and a second outlet of the second flow passage that is connected to the second suction port are formed at an end portion of the case; and
the end portion of the case is opposed to the one end portion of the fuel pump.

20. The fuel supply device according to claim 13, further comprising a check valve disposed in the second flow passage, wherein the check valve allows only a flow of fuel from an outside into an inside of the subtank.

21. The fuel supply device according to claim 20, wherein the check valve is disposed on a downstream side of the second filter element in a flow direction of fuel.

22. The fuel supply device according to claim 13, wherein:
the case includes an upper casing, which has an upper partition wall, and a lower casing, which has a lower partition wall and is attached to the upper casing; and
the upper partition wall and the lower partition wall constitute the partition wall when the upper casing and the lower casing are attached to each other to form the case.

23. The fuel supply device according to claim 22, wherein the upper casing and the lower casing are attached to each other by press fitting to form the case.

24. The fuel supply device according to claim 13, wherein a filtration area of the second filter element is larger than a filtration area of the first filter element.

25. A fuel supply device configured to supply fuel in a fuel tank to an external unit, the device comprising:
a subtank accommodated in the fuel tank, the subtank storing a part of the fuel in the fuel tank;
a fuel pump accommodated in the subtank, the fuel pump having a first pump unit, which is configured to suction fuel in the subtank thereby to supply fuel to the external unit, and a second pump unit, which is configured to suction fuel outside the subtank thereby to pump fuel into the subtank; and
a filter member that is connected to a first suction port of the first pump unit for filtering the fuel supplied to the external unit and that is connected to a second suction port of the second pump unit for filtering the fuel pumped into the subtank, wherein the filter member includes:
a case having therein a partition wall, which defines a first flow passage and a second flow passage, wherein the first flow passage directs the fuel in the subtank into the first suction port and the second flow passage directs the fuel outside the subtank into the second suction port through an opening formed on the subtank;

a first filter element configured to filter the fuel supplied to the external unit; and

a second filter element disposed in the second flow passage for filtering the fuel pumped into the subtank, wherein the second filter element is disposed such that a surface of the second filter element is generally parallel to an inner surface of the subtank, on which the opening is formed.

26. The fuel supply device according to claim **25**, wherein the first filter element is disposed in the first flow passage.

27. The fuel supply device according to claim **26**, wherein a surface of the first filter element is arranged generally parallel to the surface of the second filter element.

28. The fuel supply device according to claim **27**, wherein the first filter element and the second filter element have a plate-like shape.

29. The fuel supply device according to claim **26**, wherein:

the inner surface of the subtank is a bottom surface of the subtank; and

the case is attached on the bottom surface of the subtank such that:

a first inlet of the first flow passage opens into the subtank; and

a second inlet of the second flow passage projects from the bottom surface of the subtank into an outside of the subtank, and opens toward a bottom surface of the fuel tank.

30. The fuel supply device according to claim **29**, wherein the case is inserted into the opening of the subtank so as to be fixed to the subtank.

31. The fuel supply device according to claim **30**, wherein:

the case has a flanged portion on a sidewall thereof, and an outer diameter of the flanged portion is larger than an outer diameter of the opening of the subtank; and

the flanged portion is formed between the first inlet and the second inlet in a thickness direction of the flanged portion, and is brought into contact with the bottom surface of the subtank when the case is inserted into the opening.

32. The fuel supply device according to any one of claims **29**, wherein:

the first filter element is disposed in the first inlet; and

the second filter element is disposed in the second inlet.

33. The fuel supply device according to claim **32**, wherein:

the second inlet has a fuel passage on a sidewall thereof, and an outside and an inside of the sidewall of the second inlet communicate through the fuel passage; and

the second filter element is disposed to cover the second inlet and the fuel passage.

34. The fuel supply device according to claim **25**, wherein:

the first suction port and the second suction port of the fuel pump are formed at one end portion of the fuel pump;

a first outlet of the first flow passage that is connected to the first suction port and a second outlet of the second flow passage that is connected to the second suction port are formed at an end portion of the case; and

the end portion of the case is opposed to the one end portion of the fuel pump.

35. The fuel supply device according to claim **25**, further comprising a check valve disposed in the second flow passage, wherein the check valve allows only a flow of fuel from an outside into an inside of the subtank.

36. The fuel supply device according to claim **35**, wherein the check valve is disposed on a downstream side of the second filter element in a flow direction of fuel.

37. The fuel supply device according to claim **25**, wherein:

the case includes an upper casing, which has an upper partition wall, and a lower casing, which has a lower partition wall and is attached to the upper casing; and

the upper partition wall and the lower partition wall constitute the partition wall when the upper casing and the lower casing are attached to each other to form the case.

38. The fuel supply device according to claim **37**, wherein the upper casing and the lower casing are attached to each other by press fitting to form the case.

39. The fuel supply device according to claim **25**, wherein a filtration area of the second filter element is larger than a filtration area of the first filter element.

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